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THE APPRAISAL OF SMALL ELECTRIC PROPERTIES.

The regulation of electric utility corporations by state commissions has become general. Nearly every state in the Union has such a commission and, while in some states the authority of the public utility commission does not extend to the length of fixing the rates of the utility corporations, there is little doubt that such power will gradually be extended, so that this function will become almost universal. In defending the rates before such a commission, or in justifying any change of rates which may be deemed advisable, it is necessary that the utility corporation should not only be prepared to place a valuation upon its property but should be able to justify the figures given for such values. Figures for such a valuation and also the justification for same may be found in the records of the company where these have been kept from the beginning in such form as to show the actual amounts spent for construction and for developing the business. But it must be admitted that there are few concerns in the country which have complete records of this kind available. Where the records are not complete, an inventory of the physical property becomes necessary in order that an appraisal may be made. It will be found better from the standpoint of expense as well as from other considerations to have such an inventory prepared in advance rather than to wait until the case arises to use it. The burden of making such an inventory and appraisal will sometimes be found comparatively large in the case of small companies when such an appraisal has to be made at short notice. If the time of available employees will be used for this purpose when it is most convenient the expense of such appraisal can be greatly lessened.

The article by Mr. E. D. Dreyfus, beginning in this issue, will be found of assistance to the small company which wishes to institute work of this kind by its own corps, without the necessity of calling in a delegation of experts to do the work for it. Mr. Dreyfus has had experience of this kind in his own company and this, combined with his general qualifications as an engineer, makes his suggestions for carrying on such work both reliable and practical. In some of the states, such as Ohio, the state association has taken means to assist its members in carrying out such work. In Ohio the Public Utilities Commission required every operating utility company to make such an appraisal and consequently the incentive for co-operative work along this line was sufficient to stir the companies and

their state association to action. In other states the companies must depend upon their own resources and such help as they can gather from outside sources for carrying on this work. The suggestions of Mr. Dreyfus and the forms which he proposes for tabulating the necessary information will prove helpful to such companies.

MOTIVE POWER IN SUBMARINES.

The engineering problems associated with the design and operation of submarines are among the most interesting which are being developed as a result of the great European conflict. The question of motive power bears directly upon the efficiency of these craft as military units, and a recent review of this phase of submarine boat design by Professor William Hovgaard of the Massachusetts Institute of Technology, in a lecture before the Society of Arts, illustrates the dual importance of the internal-combustion engine and the electric motor in this field.

The gasoline engine was the first really successful motor for submarines. It was light, occupied small space as compared with previous steam machinery, and the combustion of fuel oil was not more than about 0.5 pound per horsepower-hour as against at least 1.5 pounds for steam engines. For small boats, with a displacement of from 100 to 300 tons, where weight and space were extremely restricted, the gasoline engine offered the best solution. The dangers of so volatile an oil, however, soon made it necessary to introduce heavy-oil motors, although they were in several respects inferior to gasoline engines. While the latter are easy to start, special means are required to set the former in motion, and the consumption of fuel in motors of the Koerting type was about double that of gasoline equipment. The next step was the introduction of the Diesel motor, which, although in itself rather heavy, has a fuel consumption lower than the gasoline motor. The nominal radius of action of recent boats of the largest size, driven by Diesel motors, is given as from 2,000 to 3,000 miles, the speed on the surface has attained 16 knots in several boats, and the designed speed in some boats now under construction is 18 or 20 knots. Steam machinery is still in the running, however, in connection with large submarines.

For under-water propulsion, electric power derived from a battery of accumulators still offers the best solution. Since the first appearance of this type, it has been improved in many technical details and is now reliable and durable. Batteries will stand complete charging and discharging more than 400 times, and under peace service conditions may be expected to last five or six years. The weight of lead cells per horsepower-hour, including auxiliary equipment is about 80 pounds. They permit great variations in power and are at their best in low rates of discharge, a most valuable quality for submerged work. They can be stowed low in the boat and thus add considerably to the stability. They occupy about 0.4 cubic foot less per horsepower-hour than any other source of energy at present available for this purpose.

The total accumulated energy of storage batteries is necessarily small and rarely allows more than a speed of about 10 knots for three or four hours. Recently boats have been designed for 11 or 12 knots. The radius of action at maximum speed of large boats is about 30 or 40 miles, and at reduced speed a radius of about 100 miles is claimed for some boats.

The electric motors, including switchboards and leads, weigh about 80 pounds per horsepower at the maximum rate of discharge. The excessive weight of the plant for under-water propulsion is unfortunate. Only about 30 per cent of the displacement of a submarine boat can be devoted to machinery and fuel, as against 50 per cent in a torpedo boat. The plant for under-water propulsion comes as an extra addition, and this makes it evident that submarines can never compete with torpedo boats as to speed and radius of action. Great efforts are being made to devise a type of machinery which can be used both on the surface and submerged, and especially one by which the propulsion under water does not entail any extra weight, but no satisfactory solution has yet been attained. Experiments with the so-called soda boiler may yield results in the future, but at present the electric motor is the main reliance of the submarine designer for under-water operations.

GLARE IN STREET LIGHTING.

On other pages of this issue will be found an article giving the results of researches carried out at the University of Wisconsin along lines that have previously received very little attention. Arrangements were made to mount a variety of types of lamp at different heights above the street, and tests were made by a number of observers to determine how much more light is necessary to see equally well in the presence of the glare from the street lamps as in its absence.

The results indicate very definitely that the blinding effect is much greater with lower mountings than with higher mountings, and that for common heights of mounting the amount of light required for good seeing is much greater than if this blinding effect could be avoided. Mr. Sweet concludes that mounting heights should never be less than 20 feet, but of course the most desirable height will depend upon the vertical distribution of light from the source, as well as upon other details involved in any particular installation.

One striking result of this research is that the blinding effect depends upon the total intensity of the light received at a given angle from the source, and not upon its intrinsic brilliancy. In other words, surrounding a brilliant source by diffusing glassware does not appear to reduce the blinding effect. The bearing of the contrast between the light source and the surrounding field is not clear, but as it is stated that the capacity of the eye to see is improved by

bright, rather than dark, surroundings, it is to be presumed that this contrast is an element, even though an unimportant one, in determining the effect.

In considering the blinding effect due to glare, which the author of this paper defines quantitatively to be the ratio between the increase in illumination necessary on account of the glare to see equally as well as without it, and the illumination itself, expressed as a percentage, it must be borne in mind that this effect is entirely independent of the ocular discomfort arising from the same source, since the two effects depend upon different characteristics. We use the word "glare" here as representing the physical condition which is the cause of both effects. Mr. Sweet uses the word in a slightly different sense, viewing the term from the subjective rather than the objective standpoint. We think the term is better applied to the cause or condition producing the results, rather than to the results themselves, and this, too, has been rather general practice.

The results obtained in this research elucidate a subject in regard to which the notions of illuminating engineers have been somewhat hazy, and these results may be applied in the design of future street-lighting systems to great advantage, both in the efficient use of electric energy and in providing better service to the public.

ELECTRICAL PRECIPITATION OF FUMES.

An application of electricity to another industry to which electrical engineers have given little attention was given a prominent place at the recent midwinter convention of the American Institute of Electrical Engineers and the session devoted to this topic proved the most interesting session of that convention. This topic was the electrical precipitation of fumes, a subject which is of great importance to the smelting industry. Electrical precipitation has already been applied to fumes and dust from smelters and to smoke from a variety of sources and will soon be applied also to fog if experiments in this direction should indicate that such an application would be successful. The possibility of the dissipation of fog by this means has already been amply demonstrated by the experiments of Sir Oliver Lodge in England.

The importance of the question of metallurgical smoke and fumes to both mining and agriculture is indicated by the legal proceedings which have been carried on in several places to determine the respective rights of these two interests in cases arising from the smoke of large smelters doing damage to growing vegetation. Such proceedings have resulted in the shutting down of smelters in both Utah and California and to a restriction of the output of the Tennessee Copper Company at Copperhill, Tenn. Moreover, commissions of investigation are now at work upon similar problems at Anaconda, Mont., and in California. Such results indicate the large financial interest which is at stake in the successful solution of the problem of smoke and fumes from such smelters, as unless the difficulty can be solved there will be a great sacrifice of invested capital at these and similar plants. Large expenditures have already been made in some cases for the erection of bag houses for filtering the smelter gases, and if such a method can be replaced by the comparatively inexpensive electrical method it will be a great saving to the industry.

Electrical precipitation of smelter fumes has already been applied in a number of places, the first installation being at the Selby smelter in California in 1912. Satisfactory results have generally been accomplished, although in the case of the Balaklala Consolidated Company, at Coram, Cal., shutdown finally resulted in spite of an application of electrical precipitation. In this case, apparently, the removal of solid matter from the gases was not sufficient, the large content of sulphur dioxide in the output of this smelter resulting in too great damage to permit of continued operation. It is a little difficult to realize what the output of such deleterious ingredients of smelter smoke may be in the case of a large plant, without recourse to the actual figures. Thus in the case of the Washoe smelter at Anaconda, Mont., a plant which produces about 300 tons of copper daily, there is a stack 30 feet in diameter which discharges every 24 hours over 2,000 tons of sulphur dioxide gas into the atmosphere. This, when converted into sulphuric acid through combination with water vapor would yield over 3,400 tons of acid. With such outputs as this it can be realized what damage to agriculture can be done over a considerable surrounding area and why action is necessary to render the smelter gases as harmless as possible.

The problem of electrical precipitation has received much attention from both the Research Corporation and the Mellon Institute of Industrial Research. The former body, to which Dr. Cottrell assigned his basic patents on this subject, has applied itself principally to the problem of precipitation of metallurgical fumes or white smoke. This problem has been attacked with great success and the financial returns from the commercial applications has provided funds for the institution to continue its research work. This represents a fine example of the devotion of the proceeds of scientific work to the general benefit of mankind, rather than turning the profits into private coffers. Too great recognition cannot be given to the altruism of Dr. Cottrell and his associates in this matter.

The Mellon Institute, on the other hand, is devoting its energies to the problems connected with the elimination of the black smoke which is so commonly emitted by ordinary furnaces and industrial plants, and the work done thus far shows that such smoke also can be successfully eliminated wherever its importance warrants the expense. It is to be hoped that the applications of this method will be rapidly multiplied, so as to cut down the excessive outpouring of objectional material into the atmosphere which at present takes place to such a large extent in the neighborhood of nearly every large industrial center.

Industrial Power Meeting to be Held in Cleveland.

Preparations are well under way for a two-day meeting of the American Institute of Electrical Engineers to be held in Cleveland, O., Thursday and Friday, March 18 and 19, under the auspices of the Industrial Power Committee and the Cleveland Section. The sessions will be held at the Hollenden Hotel.

The following program of papers is to be presented:

"The Principles of the Application of Electricity to the Ore-Handling Industry," by C. T. Gilpin, electrical engineer of the Wellman-Seaver-Morgan Company, Cleveland.

"The Rubber Industry—Electrical Applications and Allied Problems," by A. P. Lewis, electrical engineer of the Goodyear Tire and Rubber Company.

"Fractional - Horsepower Motor Loads," by H. A. Pratt, Westinghouse Electric & Manufacturing Company.

"Line Disturbance Caused by Special Squirrel-Cage and Wound-Rotor Motors when Starting Elevators or Hoists," by J. C. Lincoln, president of Lincoln Electric Company, Cleveland.

"Current, Torque and Power-Factor Characteristics of Alternating-Current Elevator Motors," by J. F. Lincoln, vice-president of Lincoln Electric Company, Cleveland.

"The General Principles of Motor Application," by D. B. Rushmore, General Electric Company.

"Some Trouble Encountered in the Operation of Carbon Brushes on Direct-Current Generators and Motors," by E. H. Martindale, National Carbon Company.

On Thursday night, March 18, a banquet will be held.

Fixation of Atmospheric Nitrogen.

At a joint meeting of the American Institute of Electrical Engineers and the New York Section of the American Electrochemical Society, to be held on Friday evening, March 12, at the Engineering Societies Building, New York City, the following papers, dealing with the fixation of atmospheric nitrogen will be presented: "General Survey of Present Methods," by L. L. Summers; "Cyanamide Process," by Frank Washburn; "The Carbo-nitride Process," by Samuel Peacock.

President Lincoln of the American Institute of Electrical Engineers has appointed the following committee on the Panama-Pacific convention to be held in San Francisco during the week of September 12: W. W. Briggs, chairman; A. H. Babcock, A. M. Hunt, A. G. Jones, H. A. Lardner, Harris J. Ryan, C. J. Wilson, J. T. Whittlesey, H. H. Barnes, Jr., L. T. Robinson and George F. Sever.

Electrical Manufacturers to Organize at Meeting in New York on March 9.

As announced in our issue of February 6, 1915, the organization meeting of the electrical manufacturers has been called for March 9, at 10:30 a. m., at the Biltmore Hotel, New York City. The purpose of this meeting will be to ratify the plans for organizing a permanent association of electrical manufacturers, in accordance with resolutions passed at a preliminary meeting held in New York on January 12.

R. K. Sheppard, of the B. F. Goodrich Company, chairman of the meeting of January 12, urges that all manufacturers of electrical supplies and materials entering into the manufacture of electrical equipments have representation at the meeting.

The objects of the proposed association are to provide the machinery for concerted action in matters which vitally interest the entire electrical industry. Comprehensive organization plans looking to closer co-operation with the various existing associations are to be presented at the March 9 meeting, and a committee will be appointed to thoroughly examine concentric wiring and the problems allied thereto.

Transportation Arrangements for the National Electric Light Association Convention.

Transportation arrangements for the National Electric Light Association convention, which will be held from June 7 to 11, at San Francisco, Cal., are progressing very favorably. George W. Elliott, master of transportation, has just returned to New York from an extensive trip to the Pacific Coast, whither he journeyed with T. C. Martin, secretary of the association, in order to effect arrangements and complete details with regard to the various transportation matters. Mr. Elliott states that practically everything has been provided for, and that in the way of railroad accommodation, hotels and scenic features that are outlined in the different itineraries soon to be issued, there will be presented something extraordinary in the way of travel and enjoyment. Two of the tours outlined will be over southern routes, visiting various points in Southern California, including San Diego, where the Panama-California Exposition is being held, and Coronado Beach. Plans have been perfected for a stay of two days in the Yosemite Valley.

Wherever Mr. Elliott went enthusiasm with regard to the convention was particularly noticeable, and the various cities through which the special trains will travel are arranging with the master of transportation for the complete entertainment of the visitors as they pass through. Director-General Moore of the Panama-Pacific Exposition in San Francisco, and Director-General Davis of the Panama-California Exposition in San Diego, assured Mr. Elliott of their pleasure at being able to entertain the members of the National Electric Light Association.

University of Kansas Branch Meeting.

The University of Kansas Branch of the American Institute of Electrical Engineers, in addition to the meetings usually held by organizations of this type, arranges one day each year in which the electrical engineering students are excused from attendance on regular classes in order that they may be present at this meeting of the Branch, at which several technical papers, largely by men not connected with the University, are presented. The program for the meeting this year was as follows:

Morning Session: "Keeping Standards," by G. O. Brown, of the Kansas City Electric Light Company; "The Relation of the Architect to the Engineer," by Goldwin Goldsmith, professor of architectural engineering, University of Kansas.

Afternoon Session: "Arc Lamps," by D. R. Detwiler, of the Westinghouse Electric & Manufacturing Company; "Motor Applications," by F. R. Johnson, of the General Electric Company; "Electrolysis," by F. H. Miller, University of Kansas; "The Construction of Telephone Cables," by F. B. Uhrig, of the Western Electric Company; "Construction Work," by W. J. Squires, of Kansas City, Mo.

Evening Session: "The Training of Station and Substation Operators," by A. D. Stoddard, of the Metropolitan Street Railway Company; "The Transcontinental Telephone Line," by H. C. Louderback, of the Missouri and Kansas Telephone Company; "Experiences with Alternating-Current Block Signals," by W. F. Price, of the Atchison, Topeka and Santa Fe Railway.

Baltimore Consolidated Section N. E. L. A.

At the monthly meeting of the Baltimore Consolidated Section of the National Electric Light Association on the evening of February 17, J. C. Parker, electrical and mechanical engineer of the Rochester Railway and Light Company, made a very fine address on the subject of "Public Service Corporations," dealing with the question of watered stock and the reasons for same.

Vaudeville, motion pictures and music furnished by the company's Mandolin and Guitar Club, furnished the entertainment features for the meeting.

Electricity in Ice-Cream Manufacture.

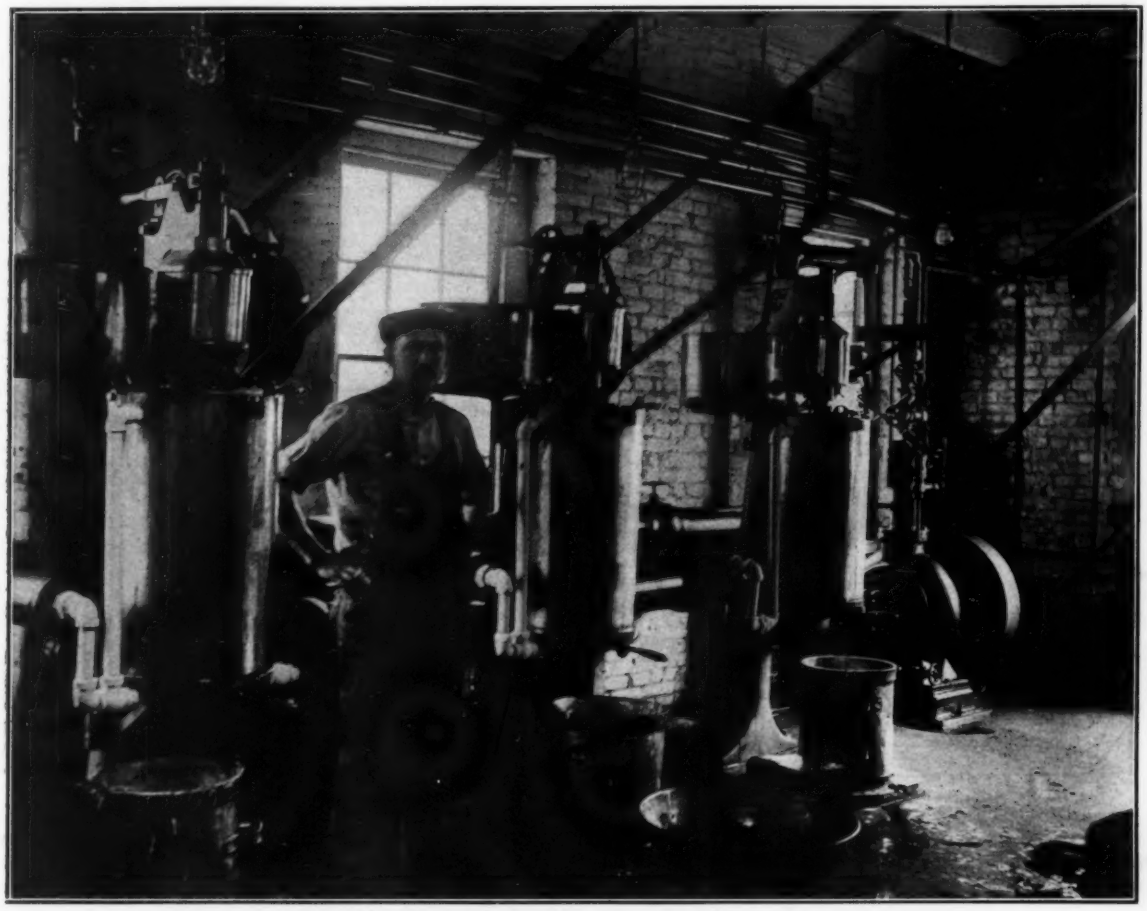
This article describes the electrical installation in a modern New England establishment devoted to ice-cream manufacturing, giving also tabulated data on the motor equipment installed.

A load of great variableness, due to the exceedingly uneven demand for the product with differing conditions of temperature and seasons, is the important characteristic in ice-cream manufacture as affecting the matter of power. With steam as the motive power, a plant having a capacity of several times the average power demand would have to be maintained to meet the requirements of the peak load of the business, which is naturally in midsummer, and particularly on the days of greatest heat. The consumption of ice-cream falls in a constantly diminishing volume as the cold season advances, except for short spurts at Thanksgiving and at Christmas. From New Year's the volume of demand rises until the week around the Fourth of July is usually the manufacturer's rush time.

This variable load is met most advantageously by the use of electric power, as a flexible and abundant energy supply is constantly on tap, the cost of energy used being in close ratio to the volume of manufactured product.

The Davis Ice-Cream Company of Cambridgeport, Mass., is one of the largest producers in the northeast. Heretofore the plant was operated with power produced by two gas engines, but their inefficiency was readily recognized as compared with electric power; hence motors were installed and connected with the local central station's power circuits, to perform all the processes of refrigeration, freezing and cold storage, and for the making of ice to be used in packing the ice-cream for shipment, together with the machines for crushing the ice and delivering the crushed ice to the delivery wagons that distribute the product throughout Greater Boston and transport it to the railroad stations and steamers for shipment to various parts of New England.

Two air compressors, of the Wagner double-action type and each having a capacity of 20 tons refrigeration, are located in the basement of the company's building on Massachusetts Avenue. These machines are belt-connected through quill-drive shafts with friction clutches, to a 75-horsepower induction motor operating on the 550-volt, three-phase, 60-cycle service, at a speed of 720 revolutions per minute on no load and 695 revolutions per minute on full load.



Two-Ton Belt-Driven Refrigerating Machine and Three Upright Ice-Cream Freezers.

Besides the two compressor units, this motor, by means of counter shafts, belt connected, operates a 7-inch worm conveyor carried in a wooden box, which carries the salt from the box cars in which it comes to the factory siding, to a large salt bin in the farther end of the basement. In addition, the motor drives a water pump

having a capacity of about 30 gallons per minute, which forces the water from artesian wells to the condensers on the roof of the building, and also a small centrifugal pump used in removing the frost from the outside of the refrigerating pipes when it becomes an impediment to circulation.

In the basement also is a 10-horsepower induction motor which operates a centrifugal pump which forces brine through the freezers on the floor above. Here are located eight Tyson freezers, made by the Tyson Company, Canton, Ohio, each of 12 gallons capacity. These are ranged in a line in the center of the freezing room and are driven by a 20-horsepower motor located on a platform and connected to the line shafting by a belt at a distance of about

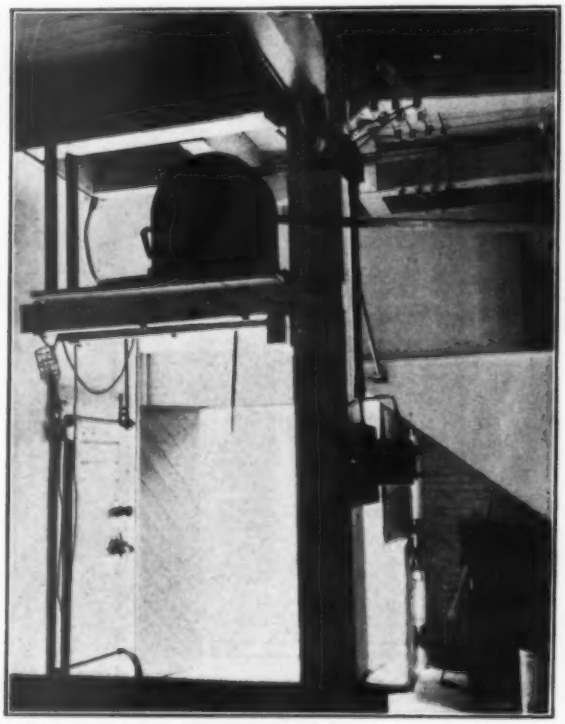
MOTOR INSTALLATION, DAVIS ICE CREAM COMPANY.

Davis Ice-Cream Company, Cambridgeport, Mass. There are from 15 to 30 persons employed, the plant working 17 to 24 hours daily, according to season. Total connected horsepower, 133.5. Total number of motors installed, 8. Average kilowatt-hours per month, 25,000. Maximum, 36,000 in midsummer. Minimum, 20,000.

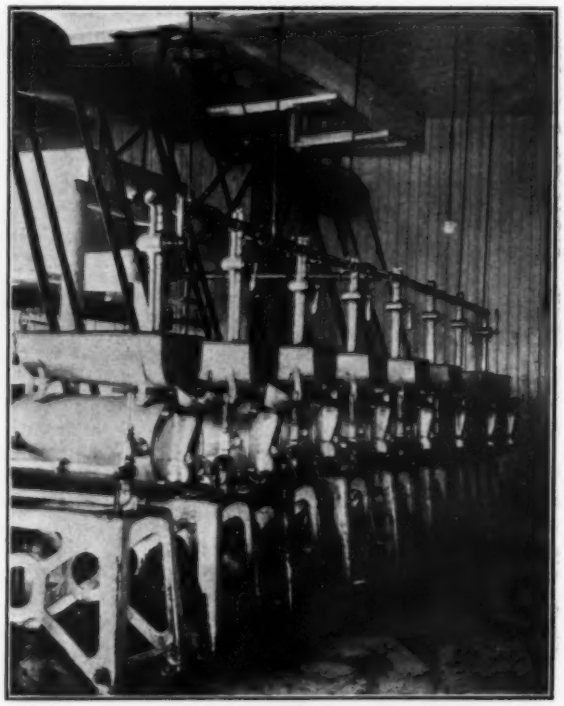
MOTORS INSTALLED.

The following is a list of the motors installed, and their drive. The supply source is three-phase, 60 cycles, 550 volts.

No.	Type.	Horse-power.	Speed no load.	Speed full load.	Application.
1	Induction	75	720	695	Belted to two Wagner double-action refrigerating compressors, each with refrigerating capacity of 20 tons; a seven-inch worm salt conveyor; a 30-gallon per minute water pump: and a de-frosting pump.
1	Vertical Shaft	2		900	Operates brine agitator for ice-making tank.
1	Induction	10	1200	1160	Belted to ice crusher and by chain drive to ice elevator and conveyor.
1	Induction	0.5		1800	Belted to auxiliary ice crusher on platform for emergency use.
1	Induction	10		1800	Operates pump for forcing brine through ice-cream freezers.
1	Induction	5	1200	1140	Drives blower to force cold air blast into storage rooms.
1	Induction	20		1200	Belted to line shaft driving eight Tyson ice-cream freezers; also agitator in cream mixing tank.
1	Slip Ring	11	900	820	Operates freight elevator.



Motor Driving Battery of Ice-Cream Freezers.



Ice-Cream Freezers Belted to Line Shaft.

15 feet between pulleys. The same motor operates a paddle agitator in the cream-mixing tank behind the freezers.

The frozen cream comes from the Tyson freezers in a semi-liquid state, and not in the solid congealed form which is familiar to the public. In this condition it is run into zinc molds and stored in a refrigerated storage room where the temperature is maintained at between five degrees below zero, Fahrenheit and zero. A second cold store-room is for the ice-cream after it is put in paper cartons, and two more rooms adjoining are for the storage of ice-cream in the large cans in which it is sent out to retailers and druggists for soda-fountain service. The temperature of the three rooms other than the one first referred to is maintained at between zero and five degrees above. A five-horsepower induction motor, operating at 1,200-1,140 revolutions per minute operates a blower which forces cold air blasts into each room.

The process of distribution of this very "perishable" commodity is second in importance only to that of manufacturing. The shipping of ice-cream, particularly in hot weather, calls for careful packing of the containers in cracked ice, and as shipments to distant points require an exposure of several hours before the ice-cream is finally consumed, an abundance of cracked ice is required.

The Davis Ice-Cream Company meets this need by manufacturing its own packing ice by the ammonia-compressor process. An ice-making tank with a capacity of 256 cans of ice, each of the cakes weighing about 225 pounds, is operated in a part of the basement, the condenser being located on the roof, as stated before, and the compressors in another portion of the basement. A two-horsepower vertical-shaft induction motor, rated 900 revolutions per minute operates an agitator to keep the brine in circulation in the tanks, moving about the ice cans and between the coils of pipe. With the brine at a temperature of eight degrees only about 30 hours' time is required to freeze the ice cakes, but with the more usual temperature of between 15 and 20 degrees Fahrenheit about 60 hours are required for the process.

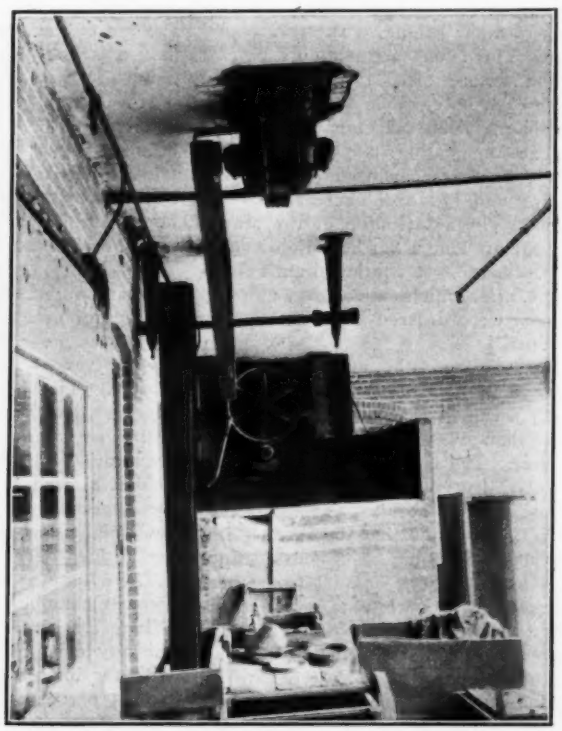
When the water in the cans becomes

frozen in solid cakes, the cans are removed from the tank, immersed in hot water, which releasse the ice cake from the can, and the cakes sent down a chute to the crusher, which is operated by a 10-horsepower motor installed inverted from the timbers of the floor above. The rated speed of this motor is 1,200 revolutions per minute on no load, 1,160 revolutions per minute on full load. It operates in addition to the crusher an elevator-conveyor which carries the crushed ice from the pit under the crusher up to the loading platforms at the side of the building. An electric bell on the platform communicates with the operator of the crusher motor, giving the signal to start and stop crushing and elevating the crushed ice. As an auxiliary to this principal apparatus, a small crusher located on the platform provides against any emergency. This is run by a 0.5-horsepower motor of the induction type, having a speed of 1,800 revolutions per minute.

During the rush period of midsummer ice-cream making itself engrosses the full time of the operatives, and natural ice is then obtained from a storehouse on a pond inland. At all other times artificial ice is used for purposes of packing for shipment.

A final motor application in this completely equipped manufactory is an 11-horsepower slip-ring motor which operates a one-ton freight elevator between the basement and four floors of the superstructure.

Motor-Driven Compressor.



Motor Driving Ice-Crusher.

The accompanying table gives the details of the motor equipment at this establishment.

Trial Installation Secures Motor Customer.

E. F. Stone, superintendent of lighting and power, Arkansas Valley Railway Light & Power Company, Pueblo, Col., recently was successful in closing a contract for 35-horsepower with the Warner Fence Company, Pueblo, after a three-months trial installation which was remarkable for its ingenuity and the accuracy of Mr. Stone's estimate of the cost of operation by electricity. The connecting rod and guides were taken off the 40-horsepower steam engine and the 35-horsepower motor mounted on the body, so the trial installation was made with little trouble and without disturbing the old prime mover. The saving effected during the trial period alone warranted the permanent installation of the motor.

Electric Lighting Adopted for Indian Railway Cars.

The Railway Board of India, whose headquarters are at Simla, has issued instructions to install electric lighting in all cars on government-operated railway systems. The change will of necessity take time to carry out, but the general adoption of electric lighting has now been decided on and will gradually be brought about as funds and time permit.

Changes in Personnel of Louisville Gas & Electric.

Numbers of interesting changes have recently been announced at the offices of the Louisville Gas & Electric Company.

Gen. George H. Harries, president of the company since the merger of the several public utilities of Louisville, has gone to Omaha, Neb., where he has been placed in charge of the Omaha Gas & Electric Company, another H. M. Byllesby & Company property. General Harries left Louisville about two months ago. It is understood that he will retain for the time the title of president of the Louisville company. Donald McDonald, vice-president and general manager, has been acting as chief executive.

G. Wilbur Hubley, superintendent of the electrical department since the merger was effective, has resigned and will enter business in Louisville, it is understood. He formerly was superintendent and chief engineer of the old Louisville Lighting Company for some 20 years.

Lewis Streng, who formerly held the title of chief engineer and who was in charge of the pipe line from West Virginia, has been made superintendent of electrical manufacturing, distribution and construction.

T. B. Wilson, secretary and treasurer, has been given, in addition, the title of assistant general manager.

L. S. Mayer, lately of Oklahoma, has been made auditor, taking up some of the duties formerly performed by Mr. Wilson.

Commercial Practice
Management, Rates, New Business

EXPERIENCE WITH MAZDA GAS-FILLED STREET LAMPS.

By Carroll H. Shaw.[1]

The city of Sheboygan, Wis., was the first of its size to adopt and install a complete system of 600-candlepower Mazda street lamps. These are 20-ampere, nitrogen-filled lamps, rated at 0.5 watt per candle, with 1,350 hours' life. The lamps are installed in Novalux fixture (No. 155,295) equipped with clear outer globe and 18-inch porcelain-enameled reflector.

The installation displaces 216 7.5-ampere series inclosed carbon arc lamps and has been increased to 224 units. The substitution of the Mazda for the arc lamps was begun on August 18, 1914, and was continued until October 3, after which date a few additional lamps were ordered in by the City Council.

In tabulating the number of hours each lamp has been in service it has been assumed that any lamp burning less than 100 hours is obviously defective. The lamp manufacturer guaranteed that the average life of the lamps should not be less than 1,000 hours, and stated that the rated life or normal would be 1,350 hours. Four groups have been created from these figures, which, while possibly somewhat arbitrary, have been found to cover a very logical range.

On February 16, 1915, the date for which the following values apply, there were 106 lamps in service that had not required renewal, and were still delivering their full candlepower, as far as could be seen. For the remaining 118 units there had been installed and burned out 149 lamps. This makes a total of 373 lamps used, including those still in service.

The following table shows the number of lamps actually burned out and their average life for various classes:

	HOURS BURNING.			
	0 to 100	100 to 1,000	1,000 to 1,350	1,350 and above
No. of lamps.....	19	55	26	49
Avg. life, hours..	22	623	1,190	1,630

In the 0 to 100 class, there were 8 lamps that burned out instantly, and only two that lived more than 50 hours. From the above data it is found that the average life of all the burned-out lamps is 980 hours. This does not take into consideration the lamps for which credit has been given by the manufacturer, and when this is done, it is found that the effective average life is 1,560 hours.

A consideration of the lamps still in service indicates that a very satisfactory life is being obtained. The average life of the 106 lamps that are still in use is 1,945 hours, while the maximum life is 2,206 hours. The average of the 118 lamps that have been installed in fixtures where burnouts have occurred is 698 hours. This list contains three lamps with more than 2,000 hours' life and 29 of more than 1,000 hours' life.

It should be borne in mind that these lamps have not yet been subject to current surges, due to lightning discharges or grounding of the lines, but they have, nevertheless, been through several very severe wind and snowstorms. The breakage of glassware has been less than ten globes for the entire six months. This indicates a very satisfactory design of glassware-holder, as well as care in handling by the inspector. Every lamp is inspected each night, and all lamps and globes are cleaned once in seven days.

The outage, as reported by the Police Department, is almost negligible. Whereas the reduction in payment by the city over a period of seven years with the inclosed arc lamps amounted to 1.17 per cent of the amount billed, the actual reduction over three months, during which the Mazda lamps were in use exclusively, is only 0.18 per cent.

In summarizing the above data, it is found that the 600-candlepower, 20-ampere, compenator street-series Mazda lamps are giving the full value of the rating as stated by the manufacturer, and it is interesting to note that had every lamp in service been burned out on February 16, the average effective life would have been 1,370 hours.

[1] Electrical engineer, Sheboygan Railway & Electric Company, Sheboygan, Wis.

A Unique Application of a Motor.

The Northern Idaho & Montana Power Company, Sandpoint, Idaho, has closed a three-year contract for power for a 35-horsepower motor which will be used at Priest River, Idaho for operating a log-loading machine. This machine will carry logs from the river to a railroad track a distance of 165 feet, including a lift of 50 feet and load the logs directly onto flat cars. By a system of pulleys the same motor will be used to shift cars before and after loading. The device will handle 3,500 logs a day.

A Farmer's Opinion of Electric Service.

The Greenfield (Mass.) Electric Light & Power Company is in receipt of an interesting communication from a rural customer who has been purchasing power since the extension of the company's lines a few years ago. This customer who, until the advent of electric service in his community, had many years' experience with the older methods of doing farm work wrote to the company as follows:

"You are certainly engaged in a work that benefits humanity. The work I have done, old railroad ties I have sawed, is wonderful at an expense of only $3.80 for power. (Signed) J. J. Greenough."

Seasonable Window Display in Boston.

The Boston Edison Company is displaying a novel and interesting window exhibit, consisting of a Lo-glo electric egg tester, a Standard electric incubator and a Standard electric brooder, products of the Electric Incubator Company, of New York.

The apparatus is arranged in a fenced yard, just within the show window, about six feet square, with a dozen live young chickens running around in the enclosure, which is furnished with scratch feed and garnished with artificial foliage.

The exhibit attracts the interested attention of the growing numbers of chicken fanciers, and is also a happy harbinger of Spring.

Big Columbus Hotel to Purchase Power.

The Deshler Hotel, a new $1,000,000 hotel to be erected in Columbus, O., has entered into a contract with the Columbus Railway, Power & Light Company for the supply of all energy to be used for lighting and power purposes. The contract is for a period of 25 years.

Commercial Lighting Campaign in Salt Lake City.

The Utah Light & Traction Company of Salt Lake City is conducting a vigorous campaign for the installation of nitrogen-filled Mazda lamps for exterior and interior lighting purposes. The company feels that this is an opportune time to make a special drive for this business in view of the fact that in the very near future large numbers of tourists will be visiting in Salt Lake City on their way to the Panama-Pacific International Exposition and that in order to create a favorable impression for the city, the commercial district should be brilliantly illuminated at night. The campaign is being built upon the slogan: "Trade Follows the Light" and it is the company's object through its advertising and through the personal work of its representatives to educate the merchants to the fact that a brilliantly lighted store and store front is the hall mark of a progressive merchant. The "Type C" Mazda offers an unusual opportunity to central stations to obtain a considerable increase in revenue at only a nominal outlay for installation on the part of the merchant, special fixtures and glassware having been developed by the manufacturers to meet this situation which can be installed at a reasonable cost.

YOUR STORE
Make YOUR store
the brightest, pleasantest, most attractive spot in your neighborhood
$12.50
UTAH LIGHT & TRACTION CO

Advertisement Intended to Interest the Merchants in Outlying Districts.

The electrical contractors of the city are co-operating with the company and have made a special proposition of $16.25 for a 750-watt "Type C" lamp complete with globe and fixture and a chain supporting bracket including 10 feet of conduit and the labor necessary to connect to the nearest circuit. For outlying stores in the residence district a special proposition of $12.50 has been made on a 400-watt lamp installed complete in the same manner. The low maintenance cost of "Type C" lamps is being urged as one of the strong points in its favor for exterior illuminating purposes.

The campaign has been supported by one of the strongest advertising campaigns ever conducted in the city. It was inaugurated by four preliminary teaser advertisements, which were run in each of the four daily newspapers. These advertisements occupied an eight-inch double-column space and were intended to attract attention and stimulate interest in the following ads. They were followed by an 18-inch five-column advertisement in the Saturday and Sunday newspapers. On Monday morning every merchant and "Type C" prospect in the city received a letter from the commercial department of

TYPE C MAZDA
Yes—
Emphatically Yes!
Business is better; money is easier and there is an increasing snap and push to things all along the line.
Its a time when business comes to those who seek it, it is a year that is going to be a GOOD year—a BIG year if we MAKE it so.
Trade Follows The Light!
Put your shoulder to the wheel!
Light your store front!
Go after the night crowds!
The crowds that shop tomorrow!
We've arranged for a special price of $16.25 for installing a 750-watt Type C Mazda, with globe, fixture, pendulous chain, supporting chain, 4-foot bracket, 10 feet of conduit, and all labor.
Call your electrical contractor or Main 32—Commercial Department—and our representative will call.
Utah Light and Traction Co.
"Electricity for Everything"
Our Electric Shop, 154 South Main.
Auerbach's Department Store, the heaviest user of electric light in Salt Lake, is lighted on its exterior and interior with Type C Mazdas. Auerbach's have proven conclusively that TRADE FOLLOWS THE LIGHT.

One of the Preliminary Advertisements in Mazda Campaign.

TYPE C MAZDA
FOUR FOOT BRACKET
$ INSTALLED COMPLETE
16.25
Supporting chain, 4 foot bracket; 1 foot pendulous chain; 750 Watt Type C Mazda; Canopy and fixture complete; 10 extra feet of conduit; including labor.
All For $16.25
A Hammered---Down Bed--Rock Price!
To Help make Salt Lake's Business District Lighter and Brighter--and YOUR Store Front, Mr. Merchant, a Trade Drawing Attraction.
$16.25 puts up a 750 Watt (approximately 1,200 candle power) Type C. Mazda complete—including four foot bracket, supporting chain, one foot pendulous chain, the globe, the canopy, the lamp itself and ten extra feet of conduit wiring and all labor of installing.
For smaller stores, throughout the residence sections, a smaller Type C Mazda can be installed complete for as low as $10.00.
Over 60 of Salt Lake's live business houses are now using Type C Mazdas.
Ask your Electrical Contractor or call Main 32 — Commercial department.
UTAH LIGHT AND TRACTION CO.
TRADE FOLLOWS THE LIGHT

"Special Price" Advertisement Which Stimulated Considerable Business.

the company inclosing a reproduction of the ad in the Saturday and Sunday's papers telling him of the purpose of the advertisement and advising that a representative of the company would call upon him to explain the proposition more fully. It was not expected that these advertisements would result in many direct sales, but it was hoped that they would stimulate an interest among the merchants which would serve as an introduction to the company's representatives. Much to their surprise, however, many telephone calls were received and the representatives learned on calling that the prospects had decided to install one or more of the lamps, and several orders were received in this way without any further effort on the part of the central-station company.

The 90-inch advertisements were followed in the middle of the week by a 60-inch ad outlining a special $16.25 offer. These were followed by a mailing card giving a list of 60 well known and progressive merchants who were using "Type C" Mazdas. Another 60-inch advertisement followed in the daily paper driving home the slogan: "Trade Follows the Light." These were followed by a 48-inch ad outlining the special proposition for neighborhood stores in the outlying districts, and then another mailing card was sent to all of the prospects. A similar advertising campaign will be continued during the months of March and April, or until such time as the city has been thoroughly solicited and the merchants impressed with the value of well lighted stores and streets.

One of the first results of the campaign was the organization of the merchants on upper Main Street, for the purpose of inaugurating a system of special street lighting for that portion of the business district, they having been brought to a realization that the lower Main Street, Broadway, and State Street merchants had attracted a considerable portion of the business to that section by their progressive and liberal use of electric lighting for exterior purposes.

The civic pride of the merchants is appealed to in one of the advertisements which reads: "Do you realize, Mr. Merchant, just how important a role you play in making Salt Lake's business district a striking, convincing advertisement for the city and state?

"When you illuminate your store front you not only draw with irresistible force the night crowds of the shopping public—but you do your share in developing the city's most attractive and profitable asset—a brilliantly lighted business section."

The campaign is being executed under the direction of Bayard W. Mendenhall, commercial agent of the Utah Light and Traction Company.

THE SALE OF ELECTRIC POWER.

By T. R. Hay.

When the central station actively entered the industrial field for the purpose of disposing of its product in its various forms, numerous manufacturing plants were easily convinced that a change from steam, gas or locally generated power to central-station power would be to their immediate and future advantage and were easily induced to contract for such service. Other plants did not come so easily, but required some effort and investigation on the part of the power company. Gradually the field covered by the individual central stations became pretty well filled with plants using central-station power, but in many instances large industrial plants were found being operated by steam, gas or locally generated power, and all efforts exerted by the central station had not succeeded in inducing them to make any change.

In order to get these plants on the lines of the central station a continued and efficient effort is necessary. In the early days such effort was not put forth, due mainly to the fact that so much easily procurable load only awaited intelligent solicitation, and that it was not, in most cases, felt that the end justified the means, and that eventually these isolated plants would become power consumers without any appreciable amount of effort being exerted on the part of the central station.

In a good many cases the attitude of the central station was justified, as in the case of the re-building or enlargement of the existing factory, re-arrangement of the equipment to keep up with an increasing and enlarging business or because of a destructive fire requiring re-building, etc.

When such fortuitous conditions as those mentioned are not present and the manufacturer still holds out in opposition to the use of purchased power, the only alternative is to sufficiently interest the prospect to the extent of obtaining authority to make a thorough analysis of the existing power conditions and layout with an alternative proposition involving the use of central-station power, and to submit same for consideration. If such a report is satisfactory from the central station's point of view, but still does not swing the prospect into line, the only thing left to do is to file the papers for ready reference and to pursue a policy of "watchful waiting." Eventually a breakdown, a rising unit power cost, due to the use of obsolete equipment, poor layout, etc., expansion, due to increased production, thus loading the existing equipment beyond its capacity, and the like will cause the manufacturer to stop and take thought and then, with the report on the plant in hand, the central station will be in a position to strike quickly and effectively and with a complete knowledge, not only of the conditions to be met and overcome, but with an accurate solution of the problem presented.

It is of course neither necessary nor advisable to spend much time and money on relatively small prospects, but on the larger ones such a course is not only advisable, but, in most cases, necessary in order to obtain such information as will make possible the drawing up of a satisfactory proposition. The report should be detailed and extensive in accordance with the size and importance of the proposition and should contain as complete and accurate information as possible. properly and logically set down and in such form as to be easily intelligible to the prospect. The prospect, it must be remembered, is, in most cases, not an engineer and does not understand lengthy and detailed engineering reports and will not take the time to study and analyze one, however much to his ultimate advantage such a course of procedure may be.

The first page of the report should contain a synopsis of the results obtained, giving existing costs, so far as possible, estimated future costs when using central-station power, estimated saving and the necessary investment to make the change. This synopsis should be followed by a few general and concise statements regarding the advantages to be derived from the use of central-station power, such as a constant speed on machines for all ranges of load, resulting in increased production at decreased unit cost; a betterment in the quality of the product, brought about by such a condition, flexibility, simplicity, cleanliness, etc. The fact that the business of the central station is the manufacture and sale of electric power should be emphasized. Such a clear and concise statement so placed in a report shows the prospect at a glance just what can be accomplished by the change.

If at all interested, the prospect will probably want to know how the results were obtained and there should follow a detailed report of the tests made, together with complete data and information, which should be set forth clearly, but in detail, so that all of the several steps of the solution shall be readily apparent. This detailed statement should be of particular value, when properly made up, if the report is to be submitted to a consulting engineer for approval.

It is not to be expected that a business man, with no particular engineering knowledge, will wade through a highly technical report to find how he will be benefited by using central-station power; hence, the desirability, even necessity, of placing the results as outlined above and in such a way that all may be readily noted and easily understood. When sub-

mitting figures for observation and comparison, gross and net results should be given, together with net cost per kilowatt-hour, with an explanation as to the amount and computation of the kilowatt-hour consumed. In order to save time the investigations should be detailed and accurate the first time, so as to be of use for some time to come. Such a procedure prevents the piling up of reports, some of little or no value through lack of sufficient information, on the same prospect, and makes available for instant use a valuable collection of information that is thoroughly logical and understandable.

Frequently, it is found that material savings in cost of operation are possible through the use of central-station power, by reducing the overhead charges, such as repairs, etc., and by making possible a more economic and efficient lay-out than may at the time exist. Elimination of lines of shafting, thus saving power lost in friction and belt slippage, proper alinement of hangers where shafting is advisable, driving machines individually or in groups, as may seem advisable, are some of the means of obtaining maximum output at minimum unit cost. Care should also be taken that a plant is not overmotored, either when the drive is individual or group. In a large plant overmotoring may cause an appreciable increase in the power bill, due to low operating efficiency of the electrical equipment and consequent high unit cost.

For the more important work, at any rate, trained and capable men should be employed at salaries commensurate with their experience and ability and the sales organization should be kept intact through good times and bad. When business is hard to get and slow in coming in, the organization should go at it harder than ever before. Each salesman should go over his assigned territory and pick out those plants that would be most desirable as customers and concentrate on them. A depression affords an opportunity of investigating such prospects in detail and of obtaining data and information for the gathering of which the necessary time would not be available when business was good. By assuring power salesmen of the stability of their positions there is given an extra incentive to dig up business and to spend some time and study on the various prospects that are located. For that matter, however, every plant that is not connected to the central station's lines as a consumer should be considered a prospect, perhaps some of them distant, but prospects nevertheless.

Where there are a number of salesmen and the ground to be covered is extensive, the territory should be divided up and each man given an assignment. Propositions originating in the different territories should be in charge of the salesman in whose territory they originate and he should have personal charge and direction of the negotiations, co-operating and consulting freely with all other departments and with the representatives of the electrical manufacturers departments for information and advice. Such a procedure insures continuity of action in the handling of the individual propositions and brings the prospect into intimate touch with one representative of the power company instead of into casual communication with a number of representatives.

It should be the endeavor of every central-station manager to build up an efficient and loyal sales organization with everybody pulling for business and working for a common end. And the watchword of such an organization should be service, service in the shape of information and advice, to prospects as well as to connected consumers.

After a prospect has been converted into a consumer further interest in his operation should not be dropped, but visits from time to time will serve to make clear any points of difference that may come up, thus keeping a satisfied customer and a booster instead of a dissatisfied customer and a knocker. Such co-operation will be to the mutual advantage of the central station and the consumer and will reduce to a minimum the chances of losing consumers that it has cost time, money and effort to connect.

Kings County Electric Light and Power Company Adds Big Power Load During Year.

The annual report of the Kings County Electric Light and Power Company for the year ending December 31, 1914, was made public recently, and shows that the company has more than held its own, though feeling keenly the general business depression. A condensed statement of earnings and expenses is given in the table.

The early indications pointed to a year of exceptional progress for the company, but the European war and the attendant general business retrenchment materially retarded its rate of growth. However, by effecting economies in expenses, and by taking advantage of the rapid development of Brooklyn as a manufacturing and business center, the net results for the year are about equal to those of 1913.

Special effort has been devoted to obtaining large power business, over seventy private plants having been replaced by the company's service, four being for over 1,000 horsepower each. Two exceptionally large contracts were taken, one with a large cordage concern for 6,000 horsepower, covering a period of ten years and another for 8,000 horsepower with the contractors on the new Rapid Transit subways. During the year 27,581 contracts were signed. In addition to the current supplied for lighting, 83,811 horsepower in motors are now operated from the company's lines.

No new financing has been done during the year, but $365,200 of the first issues of $4,000,000 six-per-cent 12-year convertible debenture bonds, dated March 1, 1910, were converted into stock, making the total of these bonds converted since the privilege became available March 1, 1913, $3,308,100.

The plant and property as shown by the balance sheet has substantially increased, and includes a horizontal Parsons type turbo-generator with condensing and auxiliary apparatus having a capacity of 22,000 kilowatts, or approximately 30,000 horsepower.

There have been no changes in the directorate or official staff. The company reports increasingly cordial relations with its customers, induced partially through the lengthening terms of service of many of its employees.

The Profit Sharing Plan inaugurated in December, 1910, was adopted for the fifth consecutive time, and on January 1, 1915, $66,596.38 was distributed to 1,080 employees. The Brooklyn Edison Investment Fund, designed for the purpose of encouraging thrift and enabling employees to invest their savings in the securities of the company, increased in usefulness, 1,381 out of the total number of 1,745 employees being voluntary depositors in the fund. One man was added to the pension roll, making a total of four, all having served the company upwards of twenty years.

Due to the abnormal conditions of the past year unusually careful supervision has been exercised throughout all departments of the organization, which procedure has enabled the company to retain in its service a great majority of its employees without wage reduction and to continue to furnish first-class service throughout the community.

	1914	1913	Increase
Total revenues	$6,346,466.38	$5,742,548.12	$603,918.26
Expenses, including taxes and depreciation charges	4,197,429.83	3,662,627.99	534,801.84
Gross income	$2,149,036.55	$2,079,920.13	$ 69,116.42
Bond interest and other income deductions	$ 864,454.86	$ 877,095.37	$ 12,640.51*
Dividends, profit sharing, etc	1,131,045.00	1,042,125.66	88,919.34
Surplus for the year	$ 153,536.69	$ 160,699.10	$ 7,162.41*
Stock outstanding, December 31	$13,308,100.00	$12,942,900.00	

*Decrease.

Electric Sign Data

Electric Sign Legislation in Massachusetts.

The Legislature of 1914, of the State of Massachusetts, created a special commission to consider the taxation and regulation of signs and to report its findings to the General Court of 1915.

The commission consisted of the Tax Commissioner, the Attorney General, and the chairman of the Gas and Electric Light Commission and of the Public Service Commission.

The report has been rendered, with a draft of an act aimed to give authority to municipalities to regulate outdoor advertising, and a draft of a constitutional amendment which would give full power to the Legislature "to regulate, restrict and prohibit advertising on public highways, in public places, and on private property within public view."

The proposed act provides for the designation of a town or city officer who shall approve or disapprove applications for the erection of signs; and for the imposing of a license fee to meet the cost of regulation. A penalty of $10 a day is provided for non-compliance with the law.

An ordinance of the city of Providence, R. I., is presented in the report, as a possible model for municipal regulation. This provides that all signs on roofs of buildings within the first building district of Providence shall be of non-combustible materials. All signs throughout the city on which electric wires and lights are installed must be non-combustible.

The constitutional amendment is offered to obviate any question as to the adequacy of Legislative powers to treat the subject.

What is claimed to be the world's largest illuminated sign has recently been installed in Chicago, at the foot of Michigan Boulevard. The sign is of metal and measures 130 feet long by 50 feet high. Illumination is provided by 24 100-watt nitrogen-filled lamps in special reflectors. The sign was erected for the Chicago *Tribune* by the Thomas Cusack Company.

A large electric sky sign to advertise the advantages of Portland, Me., is being considered. It is proposed to erect the sign on the roof of a high business block, so that it will be in view from ships in the harbor, as well as from all parts of the city. The management of the Cumberland County Power & Light Company has offered to supply current free to light the sign.

The Betts & Betts Corporation, of New York City, report a constantly increasing demand for "Klok" monograms, such as is installed on the Holmes laundry sign illustrated on this page. The Greenwood Advertising Company, of Knoxville, Tenn., has ordered a "Klok" for a large department-store sign to be erected in Cincinnati and the Federal Sign System (Electric), Chicago, will install one on the Motograph sign of the Commonwealth Edison Company, Chicago.

The A. & W. Electric Sign Company, Cleveland, O., is rebuilding the mammoth Goodrich sign on Hotel Fuller in Cleveland. The sign will represent a western scene. The construction will closely resemble a stage setting with banks of various colored lamps reflecting upon various portions of the background.

This setting will be surmounted by the Goodrich slogan: "See America First on Goodrich Tires." About 2,000 ten-watt lamps will be used.

The United Cigar Stores, Limited, of Toronto, Can., recently erected in that city a large spectacular electric sign that is attracting considerable attention. At the top of the sign is the familiar trade-mark shield of the company in which is a reproduction of the British flag, and the wording, "United Cigar Stores, Limited." Below is the wording, "Our coupons save you 3 to 7%." The flag waves continually. The wording burns continually with the exception of the word "Coupons" which flashes on and off, one letter at a time.

The sign is 35 feet high by 12 feet wide and employs 1,200 five-watt lamps. The sign was built by the Macey Sign Company, of Toronto, and the flasher was furnished by the Betts & Betts Corporation, of New York City.

Laundry sign erected in Toledo, O. Energy is supplied by the Toledo Railways and Light Company. At the upper portion of the sign is a Betts and Betts "Klok" monogram which flashes the time of day at one-minute intervals. A Betts and Betts flasher is also used. There are about 700 five-watt lamps used in the sign.

Electrical Construction

FLEXIBLE METALLIC CONDUIT IN FINISHED-BUILDING WIRING.

By Terrell Croft.

Flexible-metallic-conduit wiring for finished buildings is widely applied where high-grade work is desired and in cities where the use of metal conduit for concealed work is mandatory. It can be used in practically all locations and is frequently preferable to rigid conduit because it can be installed at less cost and in less time. It is made in lengths of from about 100 feet, for the half-inch size, to 50 feet, for the two-inch size, which promotes rapidity and ease of installation. Practically the same Code rules apply to flexible as to rigid conduit. Double-braid rubber-insulated wires must be used. Steel outlet boxes must be installed at all outlets and switches. The conduit must be continuous from outlet to outlet, must be fastened in outlet boxes with lock-nuts and bushings and it must be grounded. Due to its flexibility and the fact that it can be procured in long lengths, its application is feasible and desirable where rigid conduit could not be considered. It is particularly adaptable for finished-building wiring. No elbow fittings are required, but the duct must be securely fastened where bent to form an elbow.

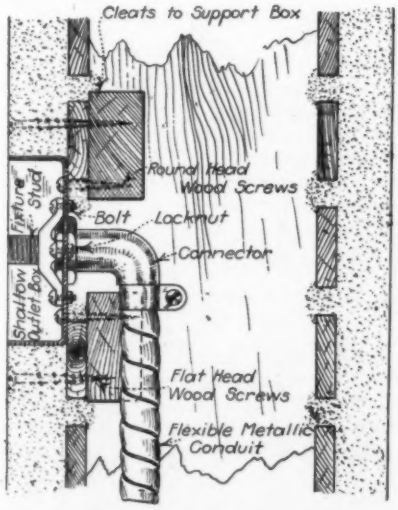


Fig. 1.—Section of Partition Showing Bracket Outlet Box and Flexible Conduit.

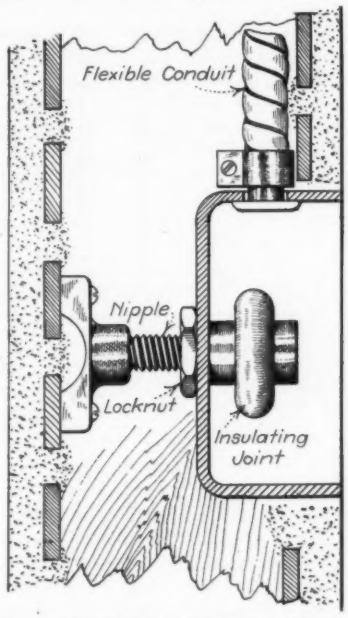


Fig. 2.—Method of Mounting Box For Bracket Electrolier.

Many fittings are manufactured especially for it.

An installation of a wall-bracket box for steel-armored cable or flexible conduit is shown at Fig. 1. The exact location of the outlet having been determined, and the wireman having assured himself that he can get his conduit to the outlet, the hole is made in the plaster for the box. Place the outlet box on the partition in the position that it is to occupy and draw a line around it with a pencil. Cut around this line with a sharp chisel down through the plaster and remove it. Cut away the section of lath extending across the center of the hole. Drop a mouse down from the hole into the partition and pull the end of the conduit up and out of the hole. Clamp a 90-degree angle connector on the end of the conduit and fasten it into the box with a locknut as shown in Fig. 1. Insert two ⅞-inch cleats, one for above and one for below, through the hole and fasten them in place inside the partition as shown, each with a couple of small-diameter wood screws turned in from the outside. Push the box back in the cavity cut for it and fasten it to the cleats with wood screws. Fasten the fixture stud in position.

The procedure in installing a switch box for flexible conduit or steel-armored cable is almost identical with that of installing a bracket box. The steel switch box is set in the recess in the partition so that the adjustable lugs rest on the lath to which the box is to be fastened and the outer edge of the box lies almost flush with the plaster surface. No. 6 flat-head wood screws are used for holding the box. When the box is used for a baseboard plug receptacle, the adjustable lugs are reversed so that the face of the box will lie flush with the face of the baseboard. In attaching flexible conduit to the box, straight or angle connectors can be used. There should never be more than two 90-degree elbows in a conduit run. Where there are more *than two* it is very difficult to draw the conductors through.

Attaching a flexible-steel-conduit or an armored-cable bracket outlet box in a partition by means of a fixture crowfoot is illustrated in Fig. 2. A hole should be carefully cut in the lath and plaster just large enough to admit the box. A crowfoot should be fixed to the lath of the opposite side of the partition with wood screws. A nipple sufficiently long to extend one-quarter inch into the bottom of the box should be screwed into the crowfoot. Turn a locknut onto

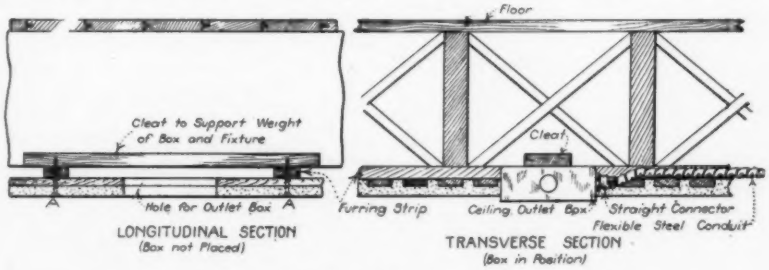


Fig. 3.—Supporting Outlet Box on a Furred Ceiling.

the nipple. With its connector attach the conduit to the box. Place the box, with its center outlet hole over the nipple, into the cavity prepared for its reception. If the hole for the box through the plaster has been accurately cut so that the box cannot wobble in it, the method provides a very firm support. In the illustration a space is shown between the sides of the box and the plaster—actually the box should just fit the hole in the plaster. This method can be used for supporting ceiling outlets.

The method of installing an outlet box for flexible metallic conduit in a furred ceiling is shown in Fig. 3. Cut the hole for the box at the correct location through the lath and plaster. Fish the

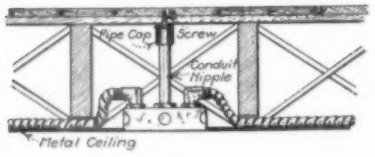


Fig. 4.—Outlet Box Attached in Ceiling.

conduit to the outlet and attach the connector. Insert a cleat, sufficiently long to bridge two furring strips, through the outlet hole and secure it directly over the hole with long, small-diameter wood screws. Attach the box to the connector and fasten the box to the cleat with wood screws. The cleat transfers any weight imposed on the box to the furring strips which will safely sustain any weight ordinarily encountered. If the screw heads are conspicuous they can be painted the color of the ceiling.

Placing the outlet boxes should be the last step in a flexible-conduit job. The boxes should not be removed after they have once been set in a wall or partition. Their removal usually disfigures the wall paper and decorations. It sometimes is necessary, prior to the completion of a job, to connect a stray conduit into some

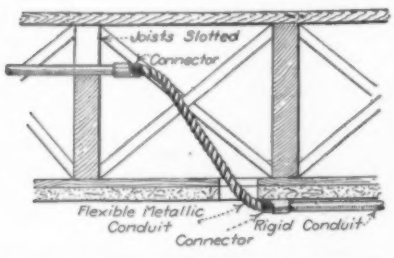


Fig. 6.—Flexible Conduit Used to Connect Two Lengths of Rigid Conduit.

box because of an obstacle preventing the installation of the conduit as originally planned. Obviously, the conduits should, where possible, be installed complete before the outlet boxes are installed.

How to attach a metallic-flexible-conduit outlet box in a metal ceiling is illustrated in Fig. 4. Cut a round hole in the ceiling just large enough to admit the outlet box. Fish the conduits to the hole and attach a 90-degree connector to each. Drill a hole, large enough to accommodate a good-sized wood screw, in the center of the pipe cap and secure the cap as illustrated to the floor above, directly over the center of the hole for the outlet box. Turn into the inverted pipe cap a conduit nipple of such a length that when the outlet box is fastened on its end the face of the box will lie flush with the ceiling surface. Run a locknut on the nipple. Put the box on the nipple, first having connected the conduits into the box. Run another locknut on the nipple to hold the box in place. If more convenient, the nipple, pipe cap and outlet box can be made up as one piece and the screw can be inserted through the nipple with a long-bladed screw-driver. A modification of the method of Fig. 2 for supporting a bracket can also be used. These methods should not be used where the fixture will be heavy.

Flexible metallic conduit must not be used where it is subjected to moisture. Sometimes inspectors will object to its installation under floors where scrubbing water might drip through. It should not be run vertically through floors where scrubbing water may affect it. If lead-covered conductors are drawn into flexible conduit so installed, the work will be in accordance with the Code, but the usual practice is to install a length of rigid conduit where an exposed run passed through a floor, as shown in Fig. 5.

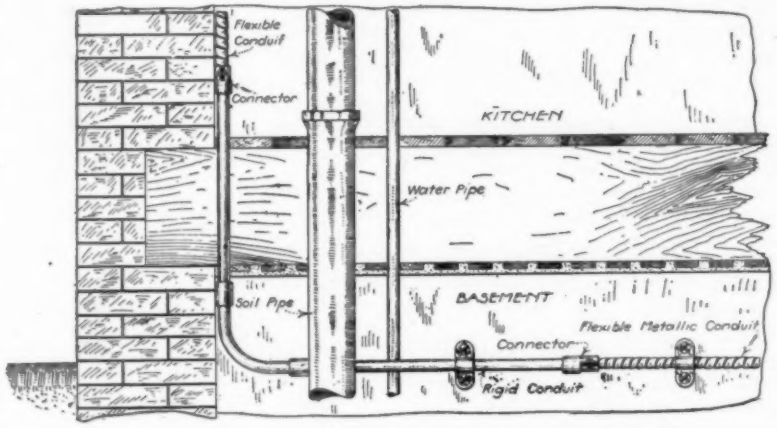


Fig. 5.—Rigid Conduit Inserted Where There Is Exposure to Moisture.

Since rigid conduit can seldom be used throughout for an entire finished-building job, it is usually necessary to combine flexible metallic conduit with it for certain portions of the work. It is also true that it is seldom desirable to use flexible metallic conduit exclusively. There are usually parts of the installation for which rigid conduit can be applied so as to save both time and cost. Where the conduit run is reasonably straight and available for manipulation, rigid conduit can usually be applied to advantage. For concealed runs, and where fishing is necessary, the flexible conduit is usually the most satisfactory.

In wiring a building with flexible conduit or flexible armored cable, usually the first operation is to locate all of the outlets, a consultation with the owner being required to effect this. Some wiremen then cut the openings for the ceiling, bracket and switch outlets. Other men, as suggested elsewhere herein, prefer to wait, if possible, until the wireways are completed before any walls or ceilings are cut. Where there is no opening into the attic, the wireman cuts one in the ceiling of a clothes closet. A trap door should be furnished for and fitted to this opening. The necessary floor pockets are cut and the conduit or cable is fished into the floor and par-

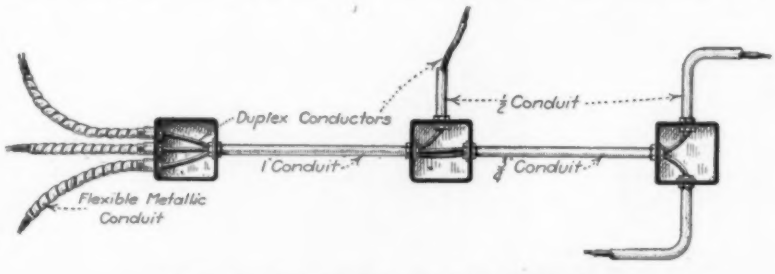


Fig. 7.—Rigid and Flexible Conduit in Combination.

tition spaces. Standard metal boxes are installed at each outlet, being affixed to the lath or to studs as herein described. For straight electroliers, substantial supports must be provided. At combination gas and electric outlets, the gas pipe serves as a support.

An illustration of flexible metallic conduit being used instead of bending rigid conduit is shown in Fig. 6. It would be quite difficult to bend a double elbow to fit in the space indicated and to connect it into the conduit line. With the flexible metallic conduit the problem is easily solved.

As previously noted, flexible metallic conduit is not approved by the Code where exposed to moisture. Where wet, damp or moist zones are encountered,

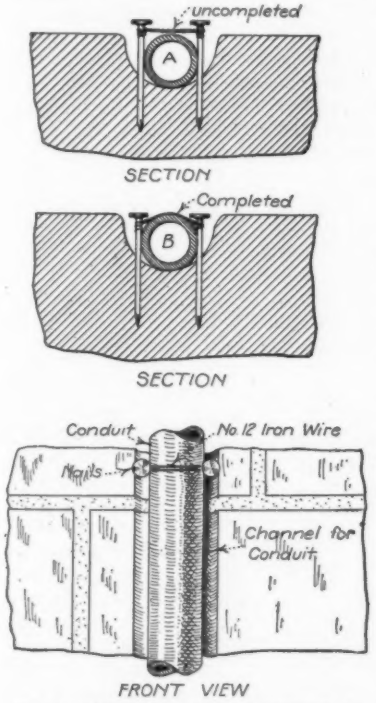


Fig. 8.—Method of Holding Conduit in Brick Wall.

along the route of the run, rigid conduit should be installed, as indicated in Fig. 5. Some of the common localities in which rigid is commonly substituted for flexible conduit are: laundries, lavatories, pump rooms, around water tanks, and bath rooms. Many inspectors consider all cellars as "damp" and insist on the installation of rigid conduit for all runs therein.

The substitution of one rigid conduit for several flexible conduits can frequently be made to effect a saving in time and material. Fig. 7 illustrates the method. The Code (Rule 26*b*) permits the same conduit to contain 4 two-wire or 3 three-wire circuits of the same system without special permission. Frequently special permission can be secured whereby more than the above special number of circuits can be carried in the same conduit. Junction boxes, as shown in the illustration, must be inserted at all points where conduit runs branch off or where there are to be splices in the conductors.

Conductors imbedded within brick or masonry walls must be incased in flexible or rigid conduit. If the wall is, or may be, damp, either rigid conduit or leaded, steel-armored cable must be used. Fig. 8 illustrates how the wall may be channeled and the conductors supported. For supporting the conduit, pipe straps are sometimes used, but the method illustrated is preferable, inasmuch as the materials required are always at hand. As shown in section A of the figure, after the conduit is in place in the groove cut in the brick, two nails are driven part way in, on opposite sides of the conduit. The ends of a piece of wire, preferably No. 12 galvanized iron, are twisted around the nails under the heads, the wire bridging the conduit. The nails are then driven home and the wire will grip the conduit tightly, as shown at B, holding it firmly in place. Such supports should be located about every two feet along the entire length of flexible conduit. After the conduit and outlet boxes are in position in a wall, the spaces around them should be filled up, flush with the wall surface, with plaster of Paris.

One vertical conduit run can often be made to serve two outlets. If it is possible to cut the holes for the outlet boxes directly opposite each other from opposite faces of the partition, a short conduit nipple can be employed to connect the two and one riser will serve both.

Georgia Contractors to Meet at Atlanta.

The Executive Committee of the Georgia Electrical Contractors' Association has decided to hold the annual convention at Atlanta, Ga., on April 15. The committee has chosen the following officers of the association: H. E. Lowe, of Macon, president; J. M. Clayton, of Atlanta, vice-president; T. H. McKinney, of Atlanta, secretary.

Among others present at the meeting of the Executive Committee, which was recently held at Macon, were: C. F. Ludwig, of Dublin; B. Levy, of Columbus; A. Brill, of Atlanta; J. A. Wire, of Athens; J. F. Brown, of Atlanta; Morris Putzel, of Macon; and S. M. Byck, of Waycross.

Henderson Electrical Store Celebrates Anniversary.

Demonstrations of all manner of electrical appliances signalized the inauguration by the Seiffert Electrical Company, of Henderson, Ky., of its new store on the first anniversary of its entry into business, March 4.

THE CONTRACTOR AND THE AUTOMOBILE.

By G. D. Crain, Jr.

"If I knew where I could get another street man as good as the man I've got, I'd hire him in a minute," said one electrical contractor to another with whom he was passing the time of day and exchanging views on the state of their business. "I could use another good man to advantage, and it would let me spend most of my time in the office. Don't know of anybody you could recommend, do you?"

"Indeed I do," his friend and competitor answered. "There is one for sale two blocks down and half a block to your left."

"What do you mean by 'for sale?'" queried the first.

"I mean a little runabout," the other replied. "I have the two best street men in this town working for me, and one of them runs on four wheels and smokes gasoline, and he cost me, rebuilt, $350."

Now, one of the biggest items in the electrical contractor's business is time. His own time, his men's time, the time getting to and from a job, the time while waiting for material, all kinds of time, enter very largely into the aggregate of the charges he has to make against every job he takes. Necessarily, he has to be paid for the time for which he pays. It must follow that his business success will be measured very largely by how economically he administers his time—all the time with which he is concerned. Much of it, of course, is stated in labor hours on the job, over which the contractor's control is limited, but there is a large amount of other time involved.

His outside man, for instance, draws so much a week, and has a given territory to cover. He may be able to close for the contractor after a few minutes' figuring with the man he has crossed the town to see. Prospects do not group themselves conveniently for the man who goes afoot or who must depend on the street cars, and many a street man spends half or more of the time he has sold to his employer in getting from one place, where he does the work he is hired to do, to another. In other words, the contractor with such a man in his employ is paying him half the salary of a first-class salesman to make trips across town where neither brains nor enterprise are required. With two men on the street, he might reasonably figure that the salary of one was going to pay for the time they spent en route.

The proposition would not bear too close inspection, of course, for no one can get away from the limitation of

flesh and blood and distances. Yet it points the statement that in the degree to which the employing contractor can lessen the time his solicitor spends on the streets can he increase his man's efficiency. If one man, with an automobile, can cover twice as much territory as the same man could without the car, it must follow that the contractor who gives his estimator-solicitor-supervisor a light automobile is virtually getting a second man "as good as" the first, for the price of the car and its upkeep. With reliable light runabouts as moderate in cost as they are, and salaries of competent electrical contractors' street men as high as they are, why shouldn't the investment be practicable?

"That is the way I hired another street man," said the contractor quoted at the outset, "and I figure that at an allowance of $100 additional a month for original cost, repairs, maintenance, etc., I will virtually have a second man and pay for the car in one year. Before we bought the runabout we kept a careful record as to the actual amount of time expended by the street man in getting from one job to another; waiting for street cars, walking from jobs to the street cars, walking all the way where the street-car trip represented a longer space of time because it was roundabout. We were astonished to find that on some days he was not actually interviewing prospective clients, estimating or supervising jobs, more than a third of his time, while the days when actual time put in in that way exceeded fifty per cent were by no means common.

"Furthermore, we came to the conclusion that the physical energy expended in walking and the effects of the weather, especially in the summer, actually reduced his efficiency. Then we bought the runabout and now distance is a small part of our troubles. I haven't detailed figures yet, but I am satisfied that when I get them they will more than bear out the assertion that the automobile is as good as a second man. Besides that, the improvement in the service is wonderful. With me sure to be in the office most of the time and in communication by telephone with the street man, who is hastening about in seven-league boots, we have an organization that has been responsible, I firmly believe, for a big increase in our business."

One reason that this contractor's attention was so readily turned to a runabout for his street man was that he had already been making excellent use of a light touring car in his construction work. In his experience in this respect there is abundant corroboration of the statement that the average electrical contractor is probably in a better position than nine out of ten contractors in other lines to make good use of an automobile. Nor does this mean that he must have an eleborate motor equipment, as many electrical contractors are finding out. This is where the electrical contractor has a special advantage.

His men are few in number on the average job; their tools, on the same kind of a job, are few and not cumbersome, he can pack in a bushel basket practically all the materials he will need on a hundred-dollar job. Where the steam-fitting contractor must have heavy wagons and elaborate tool chests, the electrical workman can carry his tools in a knapsack on his back. Where the building contractor needs a whole caravan of vehicles, one will do the average electrical contractor. There is no doubt on this score, for a number of electrical contractors are doing big businesses with no other vehicle than a $500 touring car. Those contractors who have not already invested in equipment of this character can find much to interest them and many good suggestions by inquiring into the ways in which car-owning contractors are using their vehicles.

The idea is to keep the electricians working. Their day begins with the clock, whether the contractor has the materials on hand for them to get busy with or not. If they must wait, as many of them have to do, until the wagon reaches the scene with the necessary fixtures, an armature, wire or what not, the contractor is out not only what he must pay for the delivery, but the time his men have lost. With the car available, the delivery to the job could have been made in much shorter time, while the charge for delivery would have been saved, the gain being both direct and indirect, and all in the interest of efficiency.

In a certain Middle Western town there is a young electrical contractor who engaged in the business about three years ago and who at the time was possessor of an automobile, a medium-weight car of the roadster type. He had expected to use it in his business, but he did not foresee the extent to which it would figure. After three years of hard use the car is still in serviceable condition, doing practically all the hauling the contractor requires and at the same time serving satisfactorily for his personal uses.

Nothing that is not too big for this contractor to tackle appears to be beyond the powers of this car. It is not at all unusual for his fellow contractors to see him glide up the street with two wiremen upon the seat beside him and material enough to take care of a considerable job tied on some place about the body of the vehicle. The contractor has frequently made a run of five miles or more to a job, with 400 feet of conduit pipe in bundles tied on the running boards and fenders. A motor-generator set of small capacity is easily negotiated, while the hurry-up demands on the concern are the delights of the proprietor. Service, efficiency, economy, all three are served.

A car such as this, or a touring car such as the other contractor referred to uses in his construction work, makes the contractor independent. The street cars and the passenger and freight routes may run where they will and the express-wagon driver go where he listeth, the contractor with an automobile has no occasion to consult them when he figures on a job. He can follow the lines of the electrical company wherever they go, and be assured of getting there early and with nearly everything he will need on the job. With the contractor in the office and the man at the wheel of the car calling up at stated intervals, the amount of service which can be gotten out of a car like this is large.

"That car of mine out there," said the contractor quoted, "has covered more than 6,000 miles in less than a year, according to the speedometer figures. It has just come back from taking a half-dozen fixtures and a man to put them up, out five miles into the country, and previously transported the workmen and the materials out there when the job was begun. I am sending a sick man home with it now, and when the driver drops him he will keep on going to the other side of the town to leave this rectifier and battery-charging equipment to be installed tomorrow in a garage where the owner of a country house keeps her electric. He will call me up from out there, and I may have a job waiting for him to do, such as calling at a nearby point to take a workman out on a hurry-up call to repair a damaged installation that is calling for immediate attention.

"All this helps in several ways. Attention like that would be impossible without the car. Delivery to a job would cost more without it. It saves me time, and time is money. One of the big advantages of the plan is that the car can be used just as it comes from the salesroom or from the second-hand dealer's. A smart delivery outfit would look a little more businesslike perhaps, but it would not answer the purpose as well. Besides, I do not need a regular delivery truck. I don't haul enough at one time to justify investing in one. A heavy installation calls for a dray, anyway, and they come infrequently, while the light car is useful in that connection. Besides, though its use for utilitarian purposes is rough on its looks, the same light car is a very

desirable adjunct to me personally, and it works overtime without any kind of complaint."

In these two uses for automobiles there should be a number of suggestions for the average electrical contractor. Both illustrate ways in which the automobile will save time and increase capacity, as well as reduce costs and increase service. Not only would such cars make for efficiency in a given territory, but they would enable the contractor to extend his field, irrespective of other traffic conditions.

New Electrical Rules in Springfield.

The adoption of a new building code makes a complete revolution in the requirements for electrical work within the limits of the new fire district of Springfield, Mass. Beginning March 1 permits will have to be secured for electrical work and only competent men will be allowed to do it, thus eliminating the crude amatuers who have been doing defective work while endeavoring to learn the business. The requirements of the new code are such that practically all the wiring in the business section, except that in a very few of the most modern buildings, cannot be replaced as it is at present, but must be installed in a more expensive manner in order that the fire hazard may be reduced. Changes and new work contracted for before March 1 will come in under the present building code, but after that date the more stringent requirements will be in effect and any alterations within the fire district will necessitate the installation of a large amount of new wiring and piping.

Hereafter the knob-and-tube construction that is commonly used in large business blocks and the cleat construction that prevails in the older buildings will not be permitted in any new construction within the fire district. The construction of that kind will be permitted to remain until such time as repairs or new installation is required, and then the old work will have to come out.

The requirements of the new code for all buildings within the fire district are approved rigid conduits, flexible metallic conduits, armored conductors or metal moldings, instead of the more common forms of construction that are now placed under the ban. As the fire district is much larger under the new code than heretofore, the property concerned in the change includes about all the business concerns in the heart of the city.

After the new code goes into effect it will be unlawful to begin any electrical wiring without first having secured a permit from the Building Department. The department may require detailed plans of the work, thus enabling the city officials to find out whether the one proposing to do the work is qualified. Under the present code, all that is necessary is to notify the Building Department that the electrical work is to be done and the department knows very little about what is to be done until the inspections are made. Even then the wiring inspectors have no authority to compel compliance with their suggestions, aside from the method of using the insurance companies as a club with which to enforce the desired changes.

Under the new code the inspectors will be backed up by the knowledge that a penalty of a fine for each offence confronts all who violate the law. With a specific penalty provided for violations of the law it will be possible to have the wiring done properly, without making any report to the insurance companies. The inspectors will have access to the plans for the work and then, by following the construction from the beginning, will know just what is being installed and how the work is being done. The wire inspectors last year found about one-third of all installations defective on their first visit. There were 5,600 inspections and 1,600 of the visits showed defective work on the first visit. It is stated that less than 10 per cent of this defective work was found to have been done by recognized contractors, the remaining 90 per cent having been done by amateurs. There were 154 different electricians and contractors reported last year as having done work in this city, but there are only 16 recognized contractors. Inexperienced men and school-boys frequently have been entrusted with the work and the inspectors have to make repeated visits in order that the work may be properly done. It is estimated that there were about 100 amateur electricians at work during the last year. The possibilities of fire hazard through defective work are considered very great under the conditions that prevailed under the old code. Three inspectors are employed by the Building Department for this work and they have been kept very busy looking up defective work. In one case where a young man was installing some wire, the inspectors had to make 20 visits to follow the work and to instruct the young man in his task. The new code will relieve the inspectors of a large number of reinspections and give them more time to properly follow up the new work.

The new code also requires that when electric meters have been out of service 60 days and the meter removed, a new meter cannot be installed without a reinspection.

Among the Contractors.

The Fred C. Riley Company is the name of an electrical contracting firm which has been incorporated to do business in New Haven, Conn. The incorporators are: Fred C. Riley, Harrison Hewitt and Clarence W. Bronson.

The Canterbury Electrical Supply Company, of Delaware, O., has secured the contract for electric wiring in the Park Hotel and twelve cottages connected therewith. This contract involves the installation of a power plant. This firm has also secured the contract to install an electric sign for the Delaware lodge of the Knights of Pythias.

On February 17 fire damaged the store of the G. & S. Electrical Supply Company, 305 South Warren Street, Syracuse, N. Y. The fire was soon under control, but damage to the extent of about $2,000 was done.

G. A. Eveleigh and W. H. Wood have opened a store with a full line of fixtures and electrical supplies in the Otis Building, Watertown, N. Y. This firm does a contracting business as well.

J. B. Herold has planned to open an electric shop in Olean, N. Y. Mr. Herold was at one time proprietor of the City Electric Company and for the past two years has been superintendent of the Franklinville plant of the Olean Electric Light & Power Company.

The Walker-O'Byrne Electrical Company, of Springfield, Mo., has been awarded the contract for wiring the new high school building now being built. That firm also has the contract for wiring and furnishing the lighting fixtures for the Kresge five and ten-cent store.

William Cassidy and Roland Boultinghouse have opened an electrical repair shop at Bridgeton, N. J. Their chief business is at first armature winding, commutator and elevator repairs and ignition work. Both men have special experience in this line.

A new electrical concern, under the name of the Acme Electric Shop, was recently opened at 113 West Seventh Street, Erie, Pa., by Herbert Garvin, who formerly with his brothers, Edgar and Fred, had owned one of the largest electric shops in Erie. Messrs. Fred and Edgar Garvin continue in business under the firm name of Garvin Electric Company, at 1119 Peach Street, Erie.

A $15,000 contract for wiring and lighting fixtures for St. Mary's Academy, Leavenworth, Kans., in new and old buildings has been awarded to the Squire Electric & Construction Company, of Kansas City, Mo.

National Association of Electrical Inspectors.

THOMAS HENRY DAY, President, 59 Deerfield Avenue, Hartford, Conn.
H. S. WYNKOOP, Vice-President, Municipal Building, New York, N. Y.
WILLIAM LINCOLN SMITH, Secretary and Treasurer, Concord, Mass.
JAMES E. COLE, Representative on Electrical Committee of National Fire Protection Association, City Hall Annex, Boston, Mass.

Executive Committee
EUGENE N. DAVIS, Chairman, Brookline, Mass.

SECTION REPRESENTATIVES:
C. H. Fletcher, H. Burnes, British Columbia.
A. W. Hopkins, G. W. Perry, Western New England.
Washington Devereux, A. H. Lilley, Philadelphia.
E. N. Davis, H. A. Knight, Eastern Massachusetts.
C. A. Hannan, O. E. Smith, New York City.
C. W. Mitchell, John W. Carrell, California.

MEMBERS AT LARGE:
George L. Collison, Frank R. Daniel, James H. Fenton, F. G. Hartwell, J. E. Latta, James B. McCarthy, Thomas D. MacColl, A. A. Moffitt, R. P. Strong

"LET THE CODE DECIDE."

Secretary's Message.

Every member at large, and members of all sections (except New York and Philadelphia) have been supplied with a copy of the bulletin of proposed changes in the Code and also notices regarding the convention of this Association, together with a reply postal which they have been requested to send to Mr. Braddell, stating the probability of their attendance at the banquet. The two sections mentioned I hope have been supplied directly through their officers in accordance with the suggestions made to them.

I have requested that each member at large who is unable to be present at New York should forward to me promptly his suggestions regarding any of the proposed changes with the assurance that his position will be presented at the convention and his vote recorded as he desires.

The several sections, it is intended, will in accordance with the constitution be represented at the convention by a delegation appointed as provided in the constitution (of which each section has received a copy) which will present its views and cast its vote.

The final details of the banquet and list of speakers have not been given me as yet, but announcements will be made shortly.

The first meeting of the Association will open at 10 a. m., Tuesday, March 23, in the Assembly Hall of Hotel Martinique, Broadway, and Thirty-second Street, and it is hoped that the attendance will be large and prompt, as there is a great deal of business to be gotten through with.

Notes from the Sections.

At the January meeting of the British Columbia Section a very interesting paper was read by C. H. Fletcher, the city electrician of Vancouver, upon the rules and regulations of that city governing sign construction and installation, analyzing them and comparing them with the national Code requirements. He stated that the city by-law was to be revised this year and be brought up to date, it being in places somewhat antiquated, and that one purpose of the paper was to lead up to a thorough discussion of the matter with that purpose kept in view.

The matter appearing in this section consists of questions on the National Electrical Code, its interpretation and meaning, and questions as to whether certain methods of wiring are in accord therewith. These questions are gladly received from anyone interested, even if not a member; they should be sent to the secretary with any needed elucidating sketch. They are answered by each member of the Executive Committee according to his knowledge of what the ruling would be in his jurisdiction.

It should be understood that no pretense is made to give an authoritative interpretation of the Code. This is a voluntary association; it has representation on the Electrical Committee of the National Fire Protection Association, which prepares the Code, but it has no right, and claims no right, to give a final interpretation of anything in the Code. It is only intended to give the interpretation which seems correct to the members of the Executive Committee. No attempt is made to edit or correlate the answers from the different members of the Committee, as it is felt that the occasional difference of opinion is calculated to lead to a further study of the matter in question, further discussion and the final clearing up of obscure points.

The aim is to help toward a better understanding of the Code on the part of all; a more uniform conception of its meaning; increased precision in applying it; and harmonious action of those using it, for the common good.

He stated that it had been the custom in Vancouver to allow a skeleton framework of wood to be used as a groundwork upon which to build the sign, this framework being covered with metal of the required gauge; that this sign appeared equal in strength to one completely of metal and was practically fireproof; that there had been numerous cases in which the sign had been exposed to severe fire exposure from outside and in every case had withstood it and retained its position on the building. The electrical work was of course damaged, but no more so than was the case with signs constructed entirely of metal.

The matter of supporting was considered at length, but in the absence of diagrams which evidently accompanied the original paper, it is hardly possible to abstract this portion here.

The question of placing cutouts, transformers, etc., in the sign (see National Electrical Code rule 83*b*) was discussed at length and it was considered extremely advisable to reduce the number of wires passing between sign and building and transfer a large portion of the fire risk to the outside of the building.

A considerable number of points in connection with the wiring of signs under different conditions were discussed at length, and Mr. Fletcher expressed himself as against provisions so drafted as to allow things "by special permission," as there was always a tendency toward a claim that precedents were established thereby, and when later a somewhat similar although not identical case arose and was dealt with differently, a possibility for charges of favoritism, etc., was created.

At the February meeting a paper was read by W. A. Oswald, secretary of the section and censor of motion-picture houses in Vancouver, upon rules and regulations governing moving-picture theater work, which I hope will be available in complete form for publication shortly.

The Western New England Section met on February 10 in Hartford, being called together at 11 o'clock by President G. W. Perry, city inspector of wires, of Hartford. There were fourteen present and three new members elected. The reports of the various officers were read and accepted.

A nominating committee of three was appointed and in accordance with its report (T. H. Day presiding during the election), the following list was elected for the ensuing year: President, G. W. Perry, of Hartford; vice-president, A W. Hopkins, of Springfield, Mass.; secretary-treasurer, R. J. Forsyth, of Greenfield, Mass.; Executive Committee, L. N. Heubner of South Manchester, Conn.; M. H. Mahoney, of Turners Falls, Mass.; G. S. Pitt, of Middletown, Conn.; P. O. Neuman, of Holyoke, Mass., and F. A. Whiting, of Canaan, Conn.

Mr. Perry then gave a brief address upon the object of the Association.

Adjournment was taken at 12:45 for lunch, the Association being the guest of Mr. and Mrs. Day at their home.

In the afternoon the session was continued at Mr. Day's house and after a hearty vote of thanks to the host and hostess for their hospitality the session was devoted to a discussion of the bulletin of proposed changes in the Code and the position which the Section should assume in regard to the same through its delegation, which is to consist of Messrs. Perry and Hopkins, although it is expected that a number more of the members will attend. The meeting adjourned at 4:45 p. m.

The Eastern Massachusetts Section met on Friday, February 26, at Young's Hotel, Boston, having as its guest of honor, President T. H. Day of the National Association. There were sixteen members present, who sat down to a most satisfying dinner at 2 o'clock. After an hour of pleasant intercourse about the table, the meeting was called to order by President Davis, of Brookline, who in a few well chosen words, expressed the pleasure of the Section at the presence of the National President. President Day responded in the delightful and inimitable manner which those of our members who are acquainted with him appreciate so much, but as his remarks, quite extemporaneous, were more or less in a reminiscent and personal vein, they are not reported here.

A brief reply was made by Commissioner Cole, of Boston, in the course of which Davis was heard to remark that it was certainly not a "col' day" when this Section got left.

These social amenities over, the Section turned its attention to the discussion of the bulletin of Code changes, in the course of which certain exchanges of opinion took place between our guest and leading spokesman, Brother Knight, of Worcester, but as they had been judiciously located at opposite ends of the table and the most powerful missiles at hand were olive stones, nothing serious occurred, and Knight, having executed a left-flank movement to the side of the table, out of range as it were, it was mutually decided that in fact they both really were in agreement, were mighty good fellows and such a little thing as the Code should not be allowed to interfere at all.

Owing to this digression and the fact that the bulletin contained so much matter for consideration it was decided to hold another meeting the week previous to the New York convention, and the Section adjourned at 5:45 p m., all agreeing that the meeting had been a glorious success.

Extending Service Pipe.

Question 287. After a pipe service had been installed, alterations made it necessary to extend the service pipe another length. An L condulet was used at the original terminal and the new length attached thereto. A new piece of No. 10 duplex was pulled into the new length and a splice made in the L fitting, well soldered, taped and painted. Is this according to the Code, or should a continuous piece have been used?

Answer 1(O). The fact of having the service wires spliced does not constitute a violation of Rule 26*n*, as the splice is made in an approved fitting. If, however, the extension of the service conduit is made within the building, there is introduced a possible serious violation of Rule 23*a* requiring the service fuses to be at the point of entrance.

Answer 2(U). I should say, couple the pipe without condulet according to Code.

Answer 3(P). This fitting is considered a junction box and is acceptable under the conditions named, provided it is installed in such a manner as to be accessible (see Rule 28*g*).

Answer 4(E). Splices are permitted in outlet and junction boxes. Under the conditions expressed in this question the fitting becomes a junction box. It is assumed of course that the fitting is not concealed.

Answer 5(H). The Code requires wires in conduit to be in one continuous piece without splices.

Answer 6(A). Rule 12*b* answers the question. Joints in service pipe should never be allowed. It not only leaves a weak place in the insulation, but increases the size of the wire so that it would be the bearing point in putting in and this would chafe the tape. In a fitting of this type the joints never have the same amount of compound put on to equal the insulation on the wire. When compound is used it is usually put on so tight and pulls so hard that it finally breaks, leaving the friction tape only, and that is next to no insulation. I compare this to a junction box, where I often find trouble in testing before current is turned on.

Answer 7(W). It appears permissible under the Code.

Answer 8(B). A splice in service wires between point where they enter service pipe and point where they emerge from service pipe to enter service cutout is not proper construction and should not be approved.

Answer 9(F). We require the service wires to be continuous from end to end of the service conduit. This eliminates liability of breakdown in the case of poorly made splices.

Answer 10(N). This being on street side of service cutout comes under Class B outside wiring, and not under Class C inside wiring, but Rule 12*b*, second paragraph, requires conformity to rules for unlined conduit, except conduit must be waterproof. This refers us to Rule 28 and that to Rule 26*n* to *p*. Under 26*n*, we find wire must be without splice or tape within the conduit. Under 28*b*, second paragraph, "in case of service connections and main runs this involves running each conduit continuously into a main cutout cabinet or gutter as case may be. Departure under special permission, etc." I should rule the Code required a continuous run of conduit from head to service cutout and hence wire without splice. In some special cases under last clause I might allow a junction box, but it must be waterproof and I do not think this fitting is. My reply is, it is not correct.

Locknuts on Outlet Boxes.

Question 288. Have the members any information from field practice indicating the desirability of requiring outlet boxes to be of such design that the locknuts on conduit will bear on a flat surface rather than against a curve of moderate radius?

Answer 1(O). I do not think the question raised of much importance. I have been told of tests made by the Laboratories of the conductivity of various forms of pipe connections to outlet boxes and my recollection is that the results showed good conductivity with almost any form of connection.

Answer 2(U). I think it might be advisable.

Answer 3 (P). I am not aware of any complaint in this territory against locknuts employed in connection with the round type of outlet boxes.

Answer 4(E). There has long been a doubt in the writer's mind concerning the locking of conduit to circular fittings with the usual form of locknut and bushing because of the poor and incomplete contact. In many instances the corrosion and rust would have been avoided if the locking device had been in contact with a flat surface.

Answer 5(H). It is, of course, easier to make a good electrical contact on a flat rather than a curved surface. I do not recall any Code provision, but I should prefer a flat surface for the locknut to bear upon.

Answer 6(A). I do not recall a case where there has been trouble, and if the workman is careful and sets the locknut up tight I should feel the contact was sufficient.

Answer 7(W). My experience has shown boxes with flat surfaces much preferable.

Answer 8(B). This question refers to a matter of individual opinion and not an interpretation of Code requirements. There is no question, of course, that an outlet box designed so that locknuts on conduit will make a good electrical connection is better than one so designed that contact would be a poor electrical connection, although the capacity of either might be ample for the purposes desired.

Answer 9(F). We have not experienced any trouble due to this condition, probably because the round boxes are limited to small sizes.

Answer 10(N). I have not enough experience in this territory to make any decision of much value either way. I should say that the round box, being mostly confined to outlet and small branch work, would have conductivity enough.

Terminal Fitting on Combination System.

Question 289. In a combination system, that is, part knob and tube, and part armored cable (or conduit), is it permissible to put a terminal fitting with separately bushed holes on the end of the metal construction at the point where the knob and tube begins, this fitting being covered in between floor and ceiling or within a partition?

Answer 1(O). The conduit fitting here described constitutes a junction box and under Rules 27*f* and 28*g* must be accessible.

Answer 2(U). No; the fitting becomes a junction box and cannot be concealed.

Answer 3(P). No; Rule 28*b* requires conduit to be continuous from outlet to outlet, or to junction box or cabinet; and all these must be exposed. I could not approve the plan as suggested.

Answer 4(E). It is permissible to change from one class of work to another, by a fitting such as is described, but this terminal fitting must be accessible and never concealed.

Answer 5(H). We make no objection to an installation of this description provided the wires go directly to knobs placed not more than two inches from the end of the cable.

Answer 6(A). I have always understood that the Code rules did not allow junction boxes or any fitting where metal conduit joins knob and tube. All splices should be made in outlet or junction boxes and be accessible.

Answer 7(W). See Rule 26*f*, which refers to Rule 28.

Answer 8(B). It is not permissible to change type of construction from knob and tube to armored cable or conduit work with terminal fitting at the end of metal construction if concealed.

Answer 9(F). Rule 28*g* requires conduit boxes to be accessible. This is held to mean all conduit terminal and junction-box fittings.

Answer 10(N). No; because Rule 26*f* reads "When using either conduit or armored cable in mixed concealed knob-and-tube work, the requirements for conduit work or armored cable work must be complied with as the case may be."

Public Service Commissions

Conducted by William J. Norton

CALIFORNIA.

Competition. The California Supreme Court has upheld the Railroad Commission's refusal to permit the Oro Electric Corporation to operate in the city of Stockton. The Commission's refusal was based upon the ground that another company was already supplying adequate service in that territory. This is a reversal of the position taken by this court in a decision rendered in the same case less than a year ago. In the previous decision the court had held that the city had the power to grant the franchise in question, and that no other authority could prevent the use of such franchise.

In commenting on the recent decision the Commission makes the following statement: "The decision means that the Railroad Commission is now to have the power, through the right to grant or to deny certificates of public convenience and necessity, to carry out its broad, state-wide policies in the regulation of public utilities. It means that the policies of the Railroad Commission, based on a state-wide view, can not be thwarted by purely local considerations, and that henceforth the Commission will not necessarily be bound to permit the impairment of an existing public utility service, if it is just and reasonable, by admitting a new public utility into the field unless the interests of the public clearly so require."

COLORADO.

The First Annual Report of the Colorado Public Utilities Commission has been issued covering the period from August 12, 1914, the date of the organization of the Commission, to December 1, 1914. A summary is given of the jurisdiction of the Commission, its general organization and the orders issued during this period.

IDAHO.

Southern Idaho Power Rates. The Commission has prepared a set of uniform rates for power companies operating in the southern Idaho field and has submitted the proposed rates to the power companies with the request that any objections to these rates be made without recourse to a formal hearing. The proposed rates provide a demand or service charge of 50 cents per horsepower of connected load, plus an energy charge as follows:

3.5 cents per kilowatt-hour for the first 100 kilowatt-hours.

2 cents per kilowatt-hour for the next 400 kilowatt-hours.

1 cent per kilowatt-hour for the next 500 kilowatt-hours.

0.9 cent per kilowatt-hour for the next 7,000 kilowatt-hours.

0.7 cent per kilowatt-hour for all excess over 8,000 kilowatt-hours.

These rates, on the whole, are a reduction of the present rates offered by the Great Shoshone & Twin Falls Water Power Company, the Idaho Power & Light Company, and the Utah Power & Light Company.

NEW YORK—First District.

Telephone Investigation. The legislative committee investigating the telephone situation in New York has submitted to the Legislature a report recommending changes in the public service law which will give the Public Service Commission jurisdiction over telephone companies.

Second District.

St. Lawrence Transmission Company. The Commission has approved franchises allowing the St. Lawrence Transmission Company to extend its lines from Norfolk to Hannawa Falls to connect with the lines of the Northern Power Company, and from Massena north to the Canadian border to connect with the lines of the Cedar Rapids Transmission Company of Canada, thus connecting the Cedar Rapids power with that at Hannawa Falls. The order limits the use of these lines to transmission purposes only through the towns and villages in which local companies are already doing a distributing business with the approval of the Commission.

The Buffalo General Electric Company was authorized to issue $900,000 par value of its five-per-cent, 30-year, first-refunding mortage bonds, to be sold for not less than 95 and accrued interest to net $855,000. The proceeds are to be used to reimburse the company for funds expended in the acquisition of property, and the construction and improvement of its plant and distribution system during the five years preceding December 31, 1913.

TENNESSEE.

The Tennessee Railroad Commission has issued a report for the years 1913 and 1914. A copy of the law conferring upon the Railroad Commission the power and authority to regulate and control telephone and telegraph companies is included in the report.

WASHINGTON.

The Idaho Public Utilities Commission and the Washington Public Service Commission have entered into an agreement to work together in making the valuation of the property of the Washington Water Power Company. The property of this company is located in both Washington and Idaho and it is the intention of the Commissions to co-operate so as to eliminate duplication in their work. The Washington Commission is at present engaged in the valuation of the property of this company for the purpose of rate-making.

WISCONSIN.

Wisconsin Traction, Light, Heat & Power Company. An unusual request has been brought to the Commission by the city of Neenah in its petition against the Wisconsin Traction, Light, Heat & Power Company. The respondent company serves the city of Neenah with electrical energy, which is transmitted over a 2,200-volt line from its power plants located at Appleton. The city wishes to purchase from the respondent all of the current now used for any purpose within the city of Neenah and to resell the same to the individual consumers of the respondent. In other words, the municipality proposes to act as a middleman between the individual consumers and the company. In this role, it expects to secure a low rate per kilowatt-hour by thus purchasing on an accumulative basis. This advantage it proposes to pass on to the individual electric consumers. The respondent, on the other hand, must relinquish its claim to its present consumers and refrain hereafter from selling at retail within the city.

The Commission points out that, if the municipality is permitted to effect the arrangement which it desires, its action amounts to a virtual taking away of the respondent's franchise, or right to do business, and the assertion of ownership over the business and that, if the city acquires the right to sell directly to the consuming public of Neenah, it has taken something of value from the respondent. That a company's right or franchise is property has been established by the courts. The Commission says:

"Under the public utility law a municipality can only terminate a franchise or indeterminate permit when it determines to acquire the plant of the public utility and then it must pay just compensation for the property as a going concern.

"Even if the city could lawfully condemn the franchise of the company, it would not be benefited thereby to any material extent. As the franchise is essential to the operation of the property, any damage for taking such franchise separate and apart from the property would, under any valid law, result in requiring the municipality to pay the difference in the value of the property, including the franchise, before and after the taking of the franchise.

"The fundamental proposition is that something of value is being taken from the respondents. It has built up, at some expense, no doubt, a somewhat profitable business in the locality under review. If the city acquires the business thus built up, what is to become of the so-called going value to which the respondent is entitled by the ruling of practically every court which has passed upon the question?"

The Commission further says that, if the granting of such an arrangement could be effected, the city would have to pay, in addition to the rate for the current delivered at the substation, interest, taxes, and depreciation on all the property devoted to the public use in that city; moreover, "no advantage would accrue to the city which could not be secured by filing with this Commission a request for an investigation into the reasonableness of the rates of the respondent." The Commission points out that the city in computing the net revenue under the Hopkinson schedule neglected the most important feature of public utility rate-making—the diversity-factor. "The rate referred to makes a charge for the demand at the consumer's premises and is not designed for the accumulation of demands at the Neenah substation. Nor is the output feature of this schedule designed so as to permit of cumulative billing. The fact that the total of all the consumer demands is larger than the demand at the substation will mean a considerable shrinkage in the respondent's revenues. Inasmuch as the question of rates is not up for consideration, we do not feel justified in arbitrarily enforcing such a decrease in the earnings of the company."

The Commission's final conclusion is as follows: "We conclude, then, that it is not possible for the city to acquire the business of the respondent without purchasing all of the property used and useful for the carrying on of Neenah business. Neither does it appear advisable for the city to effect this arrangement for no economies will result. . . . . The public utility law provides three remedies for municipalities when dealing with public service corporations. (1) They may elect to purchase the property used and useful to the operation of these utilities. (2) They may apply to this Commission for a certificate of necessity and convenience to allow a second or competing utility to enter their boundaries. (3) They may apply to this Commission for an order prescribing reasonable rates.

"Contrary to public opinion generally, these provisions of the statute afford as adequate remedies as were afforded to municipalities previous to its passage. The State policy has been shifted, however, so as to place more emphasis on the adjusting of rates than on the introduction of competition. The full intent of this feature of the statute is ably presented in Calumet Service Company vs. Chilton, 143 Wis. 334." An investigation to determine the reasonableness of the company's rate will follow.

The Wisconsin-Minnesota Light & Power Company was authorized to issue $36,000 of bonds for the purpose of reimbursing the company in part for expenditures in improvements and betterments in process of construction.

Electrical Engineering Problems.

By R. G. Hudson and W. V. Lyon.

DIRECT CURRENTS.

Problem 26.

A 25-horsepower 230-volt shunt motor is to be accelerated under full-load torque with a starting-box and switch as shown in Fig. 23. During acceleration the armature current must not exceed 150 amperes and when the armature current drops to the full-load value, 90 amperes, successive sections of the resistance in the starting-box are short-circuited.

If the armature resistance is 0.12 ohm, find (*a*) the proper resistances of the respective sections, AB, BC, CD, DE, and EF.

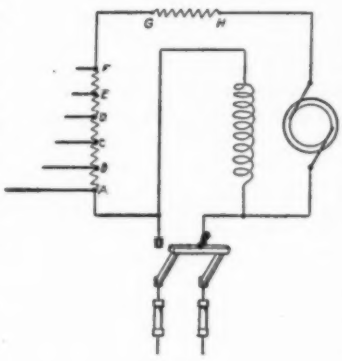


Fig. 23.

SOLUTION OF PROBLEM 26.

It was pointed out in Problem 25 that the magnitude and direction of the armature current of a dynamo depend upon three factors; terminal voltage, armature voltage and armature resistance. When the armature is at rest the armature voltage is zero and unless resistance is added in series with the armature the armature current will be given by the quotient of the terminal voltage and the armature resistance. If the armature of the motor described in Problem 25, for example, were connected across the line wires the armature current by [6] would be 230/0.12 or 1,917 amperes.

Since the armature is designed to carry not more than 90 amperes continuously or 150 amperes for a short time, a current of 1,917 amperes would soon destroy the armature winding. Such a current would also strain the armature mechanically, would burn the commutator and would open fuses and circuit-breakers between the motor and the source of power.

In starting such a motor it is necessary either to connect the armature across mains of reduced voltage or connect the armature across the regular mains with a proper amount of resistance connected in series with the armature. Since mains of reduced voltage are not usually available, the series-resistance method is generally employed. The series starting resistance is connected to a shunt motor as shown in Fig. 23. It will be observed that the shunt-field winding is connected outside of this starting resistance and therefore provides normal field flux during the starting period. To simplify the discussion, the armature resistance is shown in Fig. 23 (*GH*) connected outside of the armature.

When the line switch is closed, full voltage is impressed upon the resistance (*AH*), the emf. of the armature being zero. The motor is thus started and when acceleration ceases the section (*AB*) is short-circuited by the single-blade switch connected to *A*. After reducing the series resistance the armature current increases and the armature accelerates to a higher speed. When the speed again becomes constant the section (*BC*) is short-circuited. Successive sections of the starting resistance are thus short-circuited, the armature speed increasing in steps and the armature current varying between 150 amperes and 90 amperes. The resistances of the various sections of the starting resistance must be so chosen that the current following each resistance short-circuit will not exceed 150 amperes.

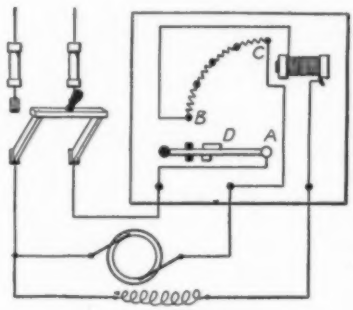


Fig. 24.

Answer to Question a.

The armature current being limited to 150 amperes in starting, the resistance (*AH*) must satisfy equation [6], 150=230/*R*. Hence *R*=230/150=1.533 ohms. The resulting armature current (150 amperes) produces a current-flux torque, which opposes the shaft torque, the stray-power torque and the inertia torque of the armature acceleration. As the acceleration decreases, the armature current decreases to 90 amperes, which produces a current-flux torque sufficient to balance the shaft torque and the stray-power torque, the inertia torque at constant speed being zero.

After reaching constant speed the potential drop in the resistance (*AH*) must equal 90×1.533 or 138 volts. When the section (*AB*) is short-circuited this potential drop is transferred to the resistance (*BH*) and this resistance must then be of such magnitude that 150=138/*R*. Hence *R*=138/150=0.92 ohm. The motor will again speed up until the armature current drops to 90 amperes and the potential drop in (*BH*) equals 90×0.92 or 82.8 volts. By short-circuiting (*BC*) this potential drop is transferred to the resistance (*CH*). The resistance of (*CH*) must then equal 82.8/150 or 0.55 ohm. Similarly, the resistance (*DH*) equals 0.55×90/150 or 0.33 ohm, the resistance (*EH*) equals 0.33×90/150 or 0.20 ohm and the resistance (*FH*) equals 0.20×90/150 or 0.12 ohm. Since this equals the resistance of the armature it indicates that the armature is now connected directly to the line and is running at its rated speed at full load.

The required resistance in each section of the starting rheostat is then given as follows:

EF=0.20—0.12=0.08 ohm.
DE=0.33—0.20=0.13 ohm.
CD=0.55—0.33=0.22 ohm.
BC=0.92—0.55=0.37 ohm.
AB=1.53—0.92=0.61 ohm.

The sum of these respective resistances plus the armature resistance (0.12 ohm) equals 1.53 ohms which is the proper resistance at starting and therefore checks the results.

The form of starting switch shown in Fig. 23 is only used for starting large motors but was used in this discussion because of its simple construction. For starting motors not exceeding 100 horsepower in capacity a starting box of the type shown in Fig. 24 is usually employed. After closing the line switch the starting handle pivoted at *A* is moved slowly to the right, making contact first at *B*. In this position the field winding is connected directly across the line and the resistance (*BC*) is connected in series with the armature. As the starting handle is moved toward *C* and the

ALTERNATING CURRENTS.

Problem 76.

The armature windings of a 5,000-horsepower, 6,600-volt, three-phase synchronous motor are connected in delta. The resistance measured between terminals at the running temperature is 0.154 ohm. The ratio of effective to true resistance is 1.6. The synchronous reactance is 5.2 ohms per phase. The friction and windage is 30 kilowatts, and the core loss, which may be assumed to be constant, is 69 kilowatts. The field current is obtained from a separately driven exciter.

(*a*) What is the full-load line current? (*b*) What are the input and power-factor at no-load if the field current is adjusted so that the armature current has its full-load value? (*c*) What is the necessary excitation voltage, both for under- and over-excitation, in question (*b*)? (*d*) If this motor delivers a load of 4,000 horsepower, over what range can the power-factor be varied without exceeding the full-load armature current, and what would be the greatest and least necessary values of the excitation voltage? (*e*) If this motor is operating alone at the end of a transmission line, which has a resistance of 0.98 ohm and a reactance of 0.86 ohm per conductor, what is the line voltage at the motor when it delivers 1,000 horsepower and the excitation is adjusted so that it takes full-load current at a leading power-factor? The voltage at the power station is 6,600 volts.

armature increases in speed, successive sections of the starting resistance are cut out. At *C* the iron keeper (*D*) is attracted by the small electromagnet connected in the field circuit and the starting handle is held securely in that position so long as current flows in the field winding.

It will be noted that as resistance is cut out of the armature circuit it is cut into the field circuit. This is done to ensure good starting torque, the current in the shunt field being greater at the instant of starting than the field winding could carry continuously without overheating. When the line switch is opened the field current does not drop to zero at once because of the energy stored in the magnetic field and because the motor begins to run as a generator at decreasing speed; the armature turning over by reason of its inertia sends current through the field winding in the same direction as before. In a short time the shunt-field current decreases to such a point that the coiled spring at *A* overcomes the attraction at *D* and returns the starting handle to its original position, leaving the motor protected for the next closing of the line switch.

SOLUTION OF PROBLEM 76.

Answer to Question a.

Just as in the case of a generator, the full-load current is computed for the condition when the motor delivers its rated output and operates at unit power-factor. The input at full load is

$$P_1=5{,}000\times746+30{,}000+69{,}000+3I^2R$$

Also, at unit power-factor $P_1=3VI$

V and I represent the terminal voltage and armature current per phase. R is the armature resistance per phase. In the case of a delta-connected armature, the resistance per phase is 1.5 times the resistance measured between terminals and in this case is $1.5\times0.154=0.231$. The effective resistance, R, is

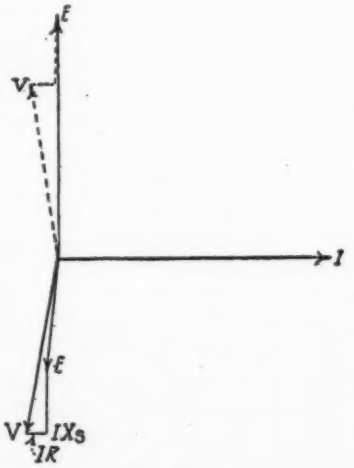


Fig. 37a.

$$R=1.6\times0.231$$
$$=0.37 \text{ ohm.}$$

The terminal voltage per phase is

$$V=6{,}600 \text{ volts.}$$

We may now write

$$3\times6{,}600I=3{,}829{,}000+3I^2\times0.37$$
$$19{,}800I=3{,}829{,}000+1.11I^2$$

The approximate value of I is $3{,}829{,}000/19{,}800=193$. Correcting this value for the armature resistance loss gives

$$I=193+1.11\times193^2/19{,}800$$
$$=193+2.1$$
$$=195 \text{ amperes.}$$

This is the method of solving a quadratic equation that was first used in Problem 75c.

In the case of a delta-connected winding the line current is

By [29a] $I_1=\sqrt{3}\times195$
$=338$ amperes.

Answer to Question b.

The input when there is no load on the motor is

$$P_1=0+30{,}000+69{,}000+1.11\times195^2$$
$$=141 \text{ kilowatts.}$$

The input per phase is one-third of this or 47 kilowatts.

By [2a] $P.F.=47{,}000/(6{,}600\times195)$
$=0.0365$

Answer to Question c.

The vector diagram is given in Fig. 37a. The full lines represent the voltages for under-excitation, while the dotted lines represent the over-excited condition. In a case like this in which the power-factor is very small and the angle between V and E is likewise very small, it is customary to assume that the numerical difference between V and E is equal to the IZ_s drop. The synchronous impedance, Z_s, is $\sqrt{R^2+X_s^2}$ and in a generator or motor is practically equal to X_s. Therefore for under-excitation

$$E=6{,}600-195\times5.2$$
$$=5{,}590 \text{ volts.}$$

For over-excitation

$$E=6{,}660+195\times5.2$$
$$=7{,}610 \text{ volts.}$$

Answer to Question d.

For a constant output under all ordinary conditions of operation a synchronous motor will operate at a smaller power-factor the larger is the armature current. In this case the power-factor has its least value when the motor takes its full-load armature current. The power input at this time will be

$$P_1=4{,}000\times746+30{,}000+69{,}000+1.11\times195^2$$
$$=3{,}125 \text{ kilowatts.}$$

By [2a] $P.F.=3{,}125{,}000/(6{,}600\times195\times3)$
$=0.809$

The current may be either leading or lagging, so that the range is from a power-factor of 0.809 with a lagging current to a power-factor of the same value but with a leading current. Refer to Figs. 34a and 35a given in Problem 75. The horizontal and vertical components of the terminal voltage are

$$V_h=-6{,}600\times0.809$$
$$=-5{,}340$$
$$V_v=-6{,}600\times\sqrt{1-0.809^2}$$
$$=-3{,}880$$

By [19a] $E_h=-5{,}340+195\times0.37$
$=-5{,}270$
$E_v=-3{,}880+195\times5.2$
$=-2{,}870$

By [20a] $E=6{,}000$ volts.

This is for under-excitation and is the smallest necessary value.

When the excitation is greater than

normal and the current is leading, the horizontal and vertical components of V are

$$V_h = -5{,}340$$
$$V_v = +3{,}880.$$

By [19a] $E_h = -5{,}340 + 195 \times 0.37$
$= -5{,}270$
$E_v = 3{,}880 + 195 \times 5.2$
$= 4{,}890.$

By [20a] $E = 7{,}190$ volts.

This is the greatest necessary value of the excitation voltage.

Answer to Question e.

We must first find the power-factor at the generating station. This can be done as soon as the power input to the line is determined, since the line current and line voltage are given. The power input to the line equals the power output of the motor plus the losses in the motor armature and in the line. Thus it is

$$P_1 = 1{,}000 \times 746 + 30{,}000 + 69{,}000 + 1.11 \times 195^2 + 3(195\sqrt{3})^2 \times 0.98$$
$= 1{,}222$ kilowatts.

By [2a] $P.F. = 1{,}222{,}000/3 \times 6{,}600 \times 195$
$= 0.318$

At the generating station the transmission line acts exactly like a synchronous motor which receives 1,222 kilowatts at a power-factor of 0.318 and a line voltage of 6,600 volts. The vector diagram which applies to this case is given in Fig. 35a. Since the line acts like a synchronous motor whose armature windings are connected in star, the applied voltage at the station must be taken as the corresponding phase voltage, i. e., $6{,}600/\sqrt{3} = 3{,}810$. The horizontal and vertical components of this are

$$V_h = 3{,}810 \times 0.318$$
$$= -1{,}210$$
$$V_v = 3{,}810\sqrt{1 - 0.318^2}$$
$$= 3{,}610$$

Let E represent the phase voltage at the motor.

By [19a] $E_h = -1{,}210 + \sqrt{3} \times 195 \times 0.98$
$= -880$
$E_v = 3{,}610 + \sqrt{3} \times 195 \times 0.86$
$= 3{,}900$

By [20a] $E = 4{,}000$

The line voltage at the motor is

$$4{,}000\sqrt{3} \text{ or}$$

Line voltage = 6,920 volts.

Notice that the line voltage at the motor is 320 volts higher than at the generating station. This action of an over-excited synchronous motor in causing a rise in voltage over a transmission line or any circuit which has considerable reactance is a very useful property. If there had been no reactance present the phase voltage at the motor would have been

$$E = \sqrt{880^2 + 3{,}610^2}$$
$$= 3{,}720$$

The corresponding line voltage would have been

$$3{,}720\sqrt{3} = 6{,}440$$

This is an example of the fact that reactance is necessary in order to obtain this rise in voltage.

DIRECT CURRENTS.

Problem 27.

A 25-horsepower, 230-volt, four-pole, lap-wound, shunt motor takes a current of 8.3 amperes from the line at no load and runs at a speed of 1,200 revolutions per minute when the field current is 2.5 amperes. The air-gap flux for any magnitude of field current is given in Fig. 25; curve A being for an armature current of 5.8 amperes and curve B for an armature current of 90 amperes. The armature resistance (hot) is 0.12 ohm.

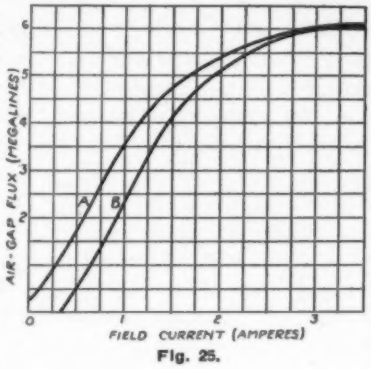


Fig. 25.

The field current being maintained constant at 2.5 amperes throughout, find the armature speed under the following conditions: (*a*) terminal voltage, 230 volts; armature current, 90 amperes; (*b*) terminal voltage, 230 volts; armature current, 5.8 amperes; a resistance of 0.5 ohm connected in series with the armature; (*c*) terminal voltage, 230 volts; armature current, 90 amperes; a resistance of 0.5 ohm connected in series with the armature; (*d*) terminal voltage, 235 volts; armature current, 5.8 amperes; (*e*) terminal voltage, 235 volts; armature current, 90 amperes; and (*f*) terminal voltage, 230 volts; armature current, 5.8 amperes; and the armature wave-wound with same number and size of conductors as when lap-wound.

ALTERNATING CURRENTS.

Problem 77.

At the end of a three-phase transmission line there are induction motors which take a total power of 1,860 kilowatts at 0.83 power-factor. The resistance and reactance of the line are 1.21 ohms and 0.98 ohm per conductor. The generators in the power station must be capable of maintaining a constant line voltage of 6,600 volts at the load. An additional load (output) of 1,200 kilowatts must be provided for. Either a large induction motor or a synchronous motor is suitable. An induction motor of this size would operate at a power-factor of 0.91 and have an efficiency of 92 per cent. If a synchronous motor is to be used it should be of such a size as to carry the additional load and also to make it possible to compensate for the lagging current taken by the induction motors so that the resultant power-factor of the entire load may be unity. (*a*) If the induction motor is used, by how much must the current output of the generating station be increased, and what will be the total line loss? (*b*) If the synchronous motor is used what should be its kilovolt-ampere capacity? Assume an efficiency of 90 per cent. (*c*) A synchronous motor of this size has a friction and windage loss of 22 kilowatts, a core loss of 51 kilowatts, and the effective resistance and synchronous reactance are 0.192 ohm and 4.18 ohms per phase. The armature windings are star-connected. If the synchronous motor is used, by how much must the current output of the generating station be increased, and what will be the total line loss? (*d*) To what value must it be possible to raise the excitation voltage of the motor?

Solutions of the above problems and two new problems will be printed in the next issue.

APPRAISEMENT OF SMALL ELECTRIC PROPERTIES.—I.

By Edwin D. Dreyfus.

Public service regulation, now in effect in all but three states and more comprehensive in some than in others, has virtually established new conditions for most of the utility companies. A leading requirement of today, therefore, is the providing of more detailed information as to the property and operation of our public service companies. It is true a number of the larger companies have in the past maintained extensive records of their systems for their own enlightenment, and it has only been necessary for them possibly to change the form and the arrangement of their data. With the small company, however, the records have been of the most general character, and of course do not admit of an intelligent analysis. Heretofore, as long as earnings were large enough to pay satisfactory interest and profits on the value placed upon the property (after all operating expenses, including current, maintenance, taxes, insurance and possibly something for depreciation reserves, had been deducted) the stockholders were usually quite content with their reports. Certainly no objections could have been raised to this practice in so far as it worked no hardship or injury upon any consumer and exerted no deterrent effect upon the progress or welfare of the community. The urban utility of the different classes has as a rule been the very corner stone upon which our modern cities have been built, and as the majority of these utilities have been privately owned, this should refute any idea that their management has throttled or retarded municipal expansion. On the contrary, private enterprise has always accomplished more in industrial promotion than where similar affairs are administered by political appointees, as history tends to show. Coming to the development of regulation we will find that several factors have contributed to the evolution of public service commissions from that of principally investigating and advisory character to that of regulatory powers.

The immobile nature of the commodity or service of the public utility as to the point or points of delivery or availability, so to speak, makes it absolutely dependent upon the locality in which the plant or system is installed. Due to the area and distance involved and the indispensable physical link and connections required, the investment necessary to serve the consumers or patrons individually is comparatively high and the "turn-over" of the capital low in contrast with the average mercantile or manufacturing business. Moreover, the degree of improvement in efficiency with the increase in concentration and growth of the load or demand stands out very prominently in public utility operation. For these and other reasons, a public utility, perforce, becomes a natural monopoly. Taking the country as a whole, although limited competition is extant, it will always be found in the last analysis quite unprofitable and more frequently ruinous and burdensome. As a corollary, a condition of monopoly must be effected on the one hand for economic reasons, while on the other hand, the rights of the people to share the benefits to be derived therefrom must be conserved. This is best done by controlling the profits which the investor may earn and the service that shall be rendered. To cope with such developments the lawmakers of the different states have created impartial tribunals to supervise and regulate the affairs of public service companies. The further removed from local influence and bias, as is generally true of state and federal commissions, the more certain that the respective rights of the utilities and the public will be weighed in balance and justice meted.

About the first thing a newly organized commission does is to put into effect rules requiring uniformity of charges as between consumers or patrons of the same class, and following thereafter proceeds usually to establish rules regulating the service. Unless impelled by an extraordinary condition, the commission presumably will merely act as an "arbiter" in case of the different complaints inevitable from the composite and probably misunderstood nature of the utility business—most of which, however, will likely be of a minor character.

A major complaint for purposes of distinction in this article will be construed as one in which excessive rates or charges are alleged. An extensive investigation will probably be required in order that the commission may determine if the allegation is correct and there is justification for a rate reduction. Yet, if there should be *prima facie* evidence to the contrary, the case may be dismissed without further action, thus avoiding a probable costly procedure. Proper scrutiny or test of the rates of a utility company can be achieved only with a definite knowledge of the fair value of the property under examination. That it pays to "set one's house in order" is no less true with the utility company than is so with other industries whose success revolves upon the removal of all uncertainties of the business that admit of reasonable solution. In fact, it would seem to be imperative that a public service company place its records in the best possible shape in view of its relationship with the public, and furthermore, at all times be able to comprehend and set forth the interrelation and interdependence of its several business components. While it is understood that there are no rules of precision that may be propounded, research may be made nevertheless which will illuminate the different factors underlying the whole business. One of the first things to be determined, as already indicated, is the amount of investment in the property, which leads us to the purpose of this article.

There may be instances, possibly, where the company's books will disclose the true value of the property (such as we may expect in the future from companies that are now starting from the ground up and maintaining their records in conformity with the classification of accounts prescribed by the public service commissions). But the practical condition before us is the fact that past accounts are invariably too meager to serve this purpose and means must therefore be had to find a value which is to be equated, mathematically speaking, as the amount of money actually invested in the property.

Discussions on valuation work and the elements that go to make up fair value, are legion and it is unnecessary at this time to refer extensively to the important contributions on this subject. But merely for the sake of a guide we refer to the estimable report of the Ohio Joint Valuation Committee.

The likelihood of an order requiring a company to submit a complete appraisal of its property evidently confronts it constantly. It is not extraordinary, then, to question why a valuation or appraisal should not be made to anticipate an investigation, we will say for rate purposes, although there may be other reasons as well. The mere possession of such information may reasonably forestall an expensive inquiry into the details of the company, and furthermore, the state of preparedness will unquestionably prove profitable. In addition to these advantages, it will, together with a study of service costs, allow of more intelligent direction of the business, which should result in a most healthy growth.

The writer has endeavored to treat the foregoing discussion in as general a manner as consistent with a clear presentation of the logic and need of a valuation in order to gauge the business from its various angles. The main drawback to the plan is the expense entailed, which the company may wish to avoid until it becomes obligatory to provide such facts. Shouldn't there be

some way of making the cost a minimum? Under a well organized plan I believe it may safely be said there is, and some suggestions toward that end follow. If a company can afford to employ or to retain experts to advise on this work, it would be obviously desirable in all cases. A company may hesitate to do this until the need of this added expense arrives. It should, however, proceed with a careful and complete inventory of its property (with adequate arrangement to make the inventory perpetual, or rather cumulative) and with a fair understanding of what constitutes unit costs, as for instance the complete construction cost of a pole set in place, including the bare cost of the pole, freight and drayage, inspection, shaving, gaining, boring, digging holes, setting, tamping, supervision, liability insurance and the like, and similar details for other items of the system, it will be no difficult matter to arrive at the cost of the physical plant being used for public convenience. The foundation will then have been laid for obtaining the entire *replacement cost,* which shall include all overhead charges and development expense. Such non-physical or intangible values comprise a number of subdivisions and may range anywhere from 10 per cent of the physical cost to 80 per cent or more, depending upon the conditions under which the plant was projected, constructed and financed. While different valuation references may be consulted and the allowance for the overhead or intangible value determined by comparative method, it is best for the sake of reasonable accuracy to build up the non-physical portion synthetically by assigning a definite amount to each main item of overhead, as the prevailing circumstances in such work will indicate.

Field Work.

Taking up specifically the inventory problem, in some detail, the work may be divided into five principal branches.

(*a*) Power plants.

(*b*) Distribution system, including meters and any other property on consumers' premises.

(*c*) Shop and store rooms, stables, garages, etc., including all material and supplies.

(*d*) Office building, fixtures and equipment.

(*e*) Other property.

This represents the general plan and manifestly each class of property is to be further divided into such detail as is necessary. It is desirable of course that in listing the inventories, the arrangements of accounts prescribed by the state utilities commission should be followed as closely as may prove convenient. At the outset the greatest delay will no doubt be in getting forms worked out so that the various elements may be properly tabulated. In recording the power-station data, the task is relatively simple on account of the assembly and accessability of all parts. Where considerable detailing is required, as in the case of the switchboard, all wiring and piping, supplementary sheets may be provided. The power-plant summary as prepared by the Wisconsin Railroad Commission and reproduced in Fig. 1, may be followed, such changes being made as local requirements may dictate. Likewise, other forms of this commission may be employed, or else those carefully prepared by the Ohio Electric Light Association. All conditions that may have had a direct or indirect bearing on the cost of construction or installation should be carefully noted. The appraiser should take particular pains to examine and inquire into all matters that may have surrounded the particular work. The condition of each piece of machinery, apparatus or structure must be closely observed.

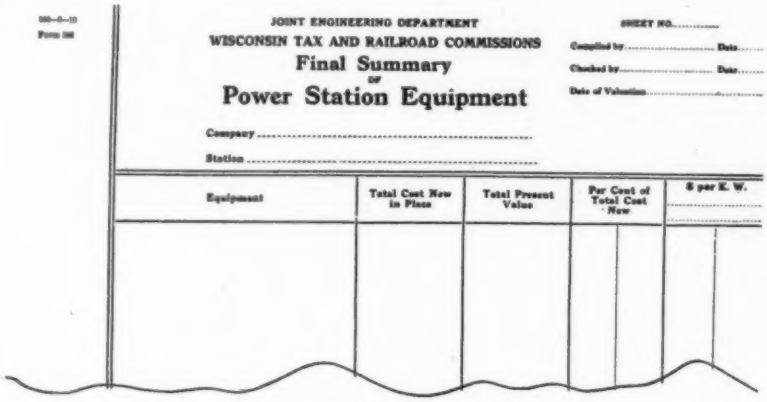

JOINT ENGINEERING DEPARTMENT
WISCONSIN TAX AND RAILROAD COMMISSIONS
Final Summary
OF
Power Station Equipment
Company
Station
SHEET NO.
Compiled by ..... Date.....
Checked by ..... Date.....
Date of Valuation .....
Equipment | Total Cost New in Place | Total Present Value | Per Cent of Total Cost New | $ per K. W.

Fig. 1.—Wisconsin Power-Plant Form.

Distribution System.

The distributing system will consume the greatest time and also will require the most attention to insure against the dangers of serious oversights or double counting. A layout of the distribution system becomes a big aid. Few small or moderate-size companies have such records. A town map giving the city or borough's streets (which should be available no matter how small the town may be) will provide a fairly good substitute. The town plat would then be divided into as many sections as will enable the work to be conducted most conveniently. This should be done primarily with regard to the manner in which the pole lines run and in such way as to eliminate all possible back travel in measuring wire lengths. It may be well to mention here that the work is being described in a somewhat elementary way so it may be readily followed by those who have so far given but limited thought to the problem. If all of the poles of the company were or could be properly located on a map, as likewise the size of the wire, a good deal of the necessary data could be obtained by scaling the drawings, due allowance being made in arriving at the amount of copper for sag and shrinkage of blueprint waste, usually about five per cent. For lack of such records, and furthermore, for the sake of accuracy, the pole lines, as a general proposition, must be completely surveyed. Either specially arranged sheets or notebooks may be employed for listing the poles and line material.

It would seem that a large sheet about 10 by 17 inches would be well to use where a full corps was at work, but where the work had to be done by a very limited number in a more or less restricted way to minimize the cost, a pocket notebook would be preferable and particularly so if any of the work happens to be carried out during inclement weather. A form of field record followed by the Ohio Electric Light Association is shown in Fig. 2, which requires little explanation. In case of the notebook it would not be so nicely ruled, but this disadvantage is easily overcome by a systematic arrangement of the data. For illustration, several pages have been taken from a book used in such work and are reproduced in Figs. 3 and 4. What is seen on these pages are simply the symbols or abbreviations so prepared as to reduce the work of setting down the information and also to keep it in condensed form. The code or key for the pole-line record is given in the following. As observed in Figs. 3 and 4, the pole-line record is divided into or arranged with five principal items:

(*a*) Pole, number or location. This gives the numerical designation of the pole, or else the street location.

(*b*) Kind. Refers to the poles used and any special features of cost that is to be included. Abbreviations selected:

Ch = chestnut.

Cs = cedar.

P = painted.

T = treated; T_{B^o}=butts only.

W = wrapped or protected above ground.

S = steps; sub-index as S_{10} indicates 10 steps.

G = guy-wire only; i. e., to adjacent pole or structure.

Gs = guy with stub pole.

Ga = guy with anchor.

Gsa = guy with both stub and anchor.

F = transformers carried on pole. Exponent indicates the number, and the sub-index the capacity, as F^3_5 indicates two five-kilowatt transformers.

L =lightning arrester.

The *prominent number* shows the *height* of the pole and the sub-index the diameter of the top in inches.[1]

Thus in Fig. 3, pole No. 209 is a 35-foot chestnut pole, seven-inch top, with lightning arrester, having 11 steps and guyed with anchor.

(*c*) *State.* The age and general condition of the pole are set down thus, 2—good—⅛ inch, meaning that the pole is two years old, and the upper part of the poles, i. e., which is above the ground line, is good and the pole at the ground line has decayed to an extent of one-eighth inch over the greater part of the circumference.

(*d*) *Cross-arms.* Covers the arm equipment with the following symbols:

P = pins.

D = double arm.

Bu = buck arm.

Thus pole No. 209 (Fig. 3) has one six-pin buck arm.

(*e*) *Insulators.*

Gl = Glass.

$Porc.$ = Porcelain.

At the right side of the page the horizontal distance between poles is indicated by arrow lines, the size and number of wires strung between the poles is given, and in addition the condition of the wire covering.

It would be well to further show after each wire or group of wires the kind of circuit to which it is applied with symbols, as:

P = primary wires.

S = secondary wires.

A = arc circuit.

T = tungsten street lighting where independent of arc circuits.

Furthermore it may prove profitable to go one step beyond this and apportion by careful judgment, primary and secondary wires among the following uses:

D = domestic.

C = commercial.

R = power.

Such additional information would be more satisfactory than to depend entirely upon apportioning the investment caused by the different classes of consumers in accordance with their connected loads or respective demands.

When these data have been gathered in the form outlined they are readily converted into useful statistics by employing a systematic tally, i.e., the assortment of information desired is arranged and as the information contained in the field book is called, the same is jotted down by a mark under the proper headlines.

Condition of Property.

It has been noted that the condition of the different elements of the property must be observed—in other words, the degree of mechanical deterioration. Such other factors which reduce the value, as inadequacy, lack of utility and other reasons would in practically all cases stand out quite prominently and will not require the same close inspection as when declining value is due to wear and tear, the elements, abuse, destruction by animals, insects, fungi and chemicals, etc. A great deal of injustice may result from any haphazard plan of arriving at the amount of so-called depreciation. Several authorities on depreciation may be consulted, as likewise a vast amount of technical literature. As already noted and as previously stated, no hard and fast rule may be safely applied to this work. Therefore trained judgment becomes virtually indispensable in this connection. Engineers pretty much follow the practice of estimating the cost to restore the apparatus or material to original value wherever this may be done. The expense of the repair compared with the first cost of the equipment in question fairly shows the accrued depreciation. If the element is of such a nature that it may never be reclaimed after it has once

O. E. L. A. Form 401

4DEPRECIATION
A MECHANICAL DETERIORATION
B OBSOLESCENCE
C LACK OF UTILITY
D ANY OTHER CAUSE

NAME OF COMPANY _____

LOCATION OF PROPERTY _____

SHEET NO. _____
VALUATION AS OF _____
DATE COMPILED _____
COMPILED BY _____
CHECKED BY _____

INVENTORY OF OVERHEAD LINES

STREET LOCATION	POLES				% DEPRECIATION	JOINT OCCUPANCY	HEIGHT TO TOP OF L. OR T. UTILITY L. OR T.	CROSS ARMS					PINS		INSUL	WIRES					GUYS			ST. LAMPS		NUMBER AND KIND OF STEPS, GUY INSULATORS AND CLAMPS TRANSFORMERS, LIGHTNING ARRESTERS, MISCELLANEOUS EQUIPMENT AND OTHER REMARKS.
	KIND	HEIGHT	TOP DIAM.	PAINTED				NUMBER	KIND	PIN HOLES	BRACES	% DEPRECIATION	NUMBER	KIND	NUMBER	NUMBER	SIZE	KIND	SPAN	% DEPRECIATION	KIND	LENGTH	SIZE	NUMBER	KIND	

Fig. 2.—Form For Overhead Lines Prepared by Ohio Electric Light Association.

[1] For methods of readily determining pole heights, see article on "Determination of Heights and Distances for the Line Construction Man," by A. N. Bancroft, ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, Vol. 65, p. 1038, November 28, 1914.

been placed in service, i.e., necessitating removal after its quality or integrity has seriously suffered from a mechanical or economical standpoint, then the residual wearing value is to be appraised, and accordingly the extent of depreciation, having properly considered the conservative scrap value, if any.

While it is not to be denied that expectancy-of-life tables are extremely useful in this work, since the law of averages applies with equal force and effect in this instance as it does in all other cases where the human element is a factor, entire dependence upon them may establish erroneous results as already indicated. The degree of treatment in operation and protection provided against ravaging agents offers an exceedingly wide latitude for variation. Consequently specific study must be made of all parts of the system where accuracy as to the state of depreciation or the lessening of value becomes of real importance, as later discussed. As an aid in adjusting depreciation for local conditions, the use of characteristic results is recommended. The depreciation problem of wooden poles will be briefly considered for illustration as in Figs. 5 and 6. The cedar pole, which is most extensively used in the West and Middle West, is very stout and substantial. If the same is properly selected, cut at the right time and seasoned adequately, and furthermore, installed under favorable conditions, it should remain serviceable 30 years. Evidently this is about the outside limit of life or service, and the conditions to produce such long life must manifestly be *excellent*. It is not necessarily extraordinary that cedar poles last 25 and 30 years, and they may be graded as in Fig. 5 to a point of 10-year life which is plainly *poor* for cedar quality. Admittedly there have been cedar poles erected which have had to be replaced within even less than half this time, due to excessive heart-rot and other abnormal defects or from injury, but if such factors are present, in all probability they will be detected by a competent observer. Likewise with chestnut poles, which are increasingly used in the Eastern and Atlantic States, quality gradients are similarly determined upon.

That part of the pole above the ground line may be in accordance with graded life as set down in Figs. 5 and 6. However, butt-rot (due to lack of preservatives and unfavorable soil condition) may materially affect these values. To allow for this phase and to extend the use of these charts, diagonal lines and ordinates for different average depths of circumferential butt decay in inches, have been added, which quickly permit the further reduction in depreciation thereby to be made. Directional lines in Fig. 5 is an exhibit of where a *good* cedar pole, in service for 10 years, has a one-inch average butt-rot and consequently a percentage value of 45. The deduction for butt decay is based upon restoring the pole by the use of butt reinforcement or else considering its value as a shorter pole. As the restoration cost is practically constant for all conditions of decay, the less the residual value, the greater the effect of the reduction. In like manner other parts of the property may be considered and the depreciation arrived at methodically.

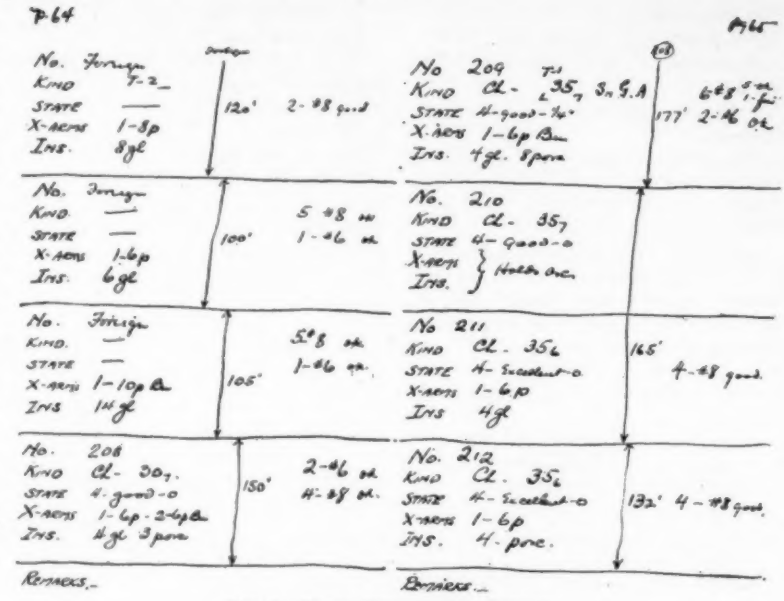


Fig. 3.—Pages From Field Notebook.

There is much evident confusion as to purposes of depreciating accounting, and while the writer recommends a careful study of the condition of the property, he does not take the view that the amount of depreciation found should be deducted from the original or reproduction cost to fix the present value. The primary object in determining depreciation should be to ascertain the liabilities accrued or accruing for replacements. Since regulation has been inaugurated the need of an adequate gauge of the general state of the property is necessary so that the accounting may be maintained strictly in accordance with the prescribed clas-

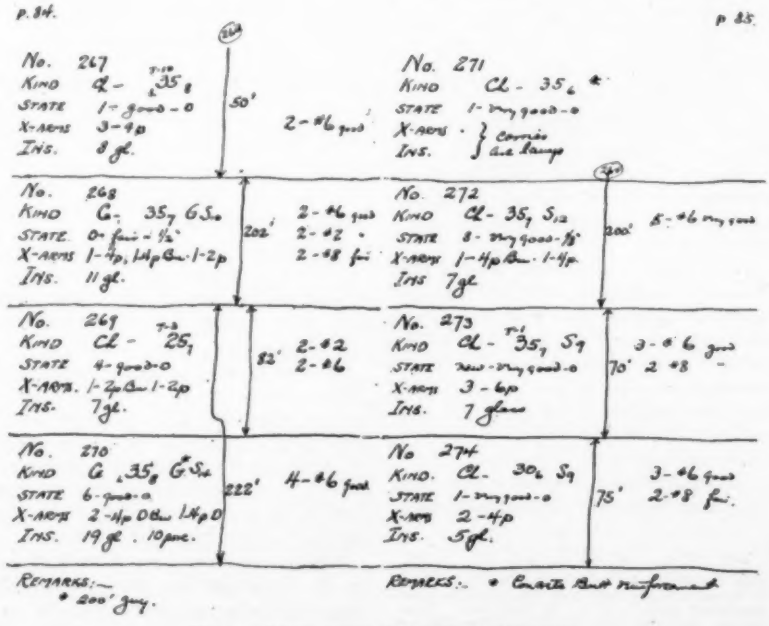


Fig. 4.—Other Pages From Field Notebook.

sification. Moreover, able management now recognizes the necessity of frequent use of the "yard stick" so as to know rather minutely all of the possible requirements of the property and particularly as to replacements to be provided for. These should be the primary reasons for recording the depreciation and not as a deduction to be *made from capital account.* This question in itself has and will continue no doubt to provoke lengthly discussion. Some of our prominent leaders[2] on public-utility and economic problems have expressed themselves very emphatically on this subject.

An article on appraisal work would be to an extent incomplete at this time if proper reference were not made to the new attitude that is developing relative to this phase of the depreciation problem.

The courts and commissions have, as to be expected, been carried along by the current of precedents. And these, so far, have generally been for the subtraction of the accrued depreciation. Unfortunately this idea has acquired an almost overwhelming inertia with our judiciary and regulatory bodies, such that continued effort must be made to arrest the tendency. On the one side there are apparently plausible arguments that the depreciation should be deducted mainly on the grounds that if an allowance for depreciation had been earned and not been set aside for the single use of the property or applied in some appropriate way for its benefit, it is to be constructed as the equivalent of so much of the investors' capital having been repaid or otherwise amortized. Consequently the ratepayer is not to be required to pay returns upon such portion of the investors' original capital. Furthermore, it is claimed that a well maintained property will in course of a short time after having been put into service, settle down to a value as regards capital worth of, roughly, 75 to 85 per cent of the original cost—although the service value remains at 100 per cent—and therefore the fixed capital represented by the property is to be accordingly readjusted.

The opposing argument rests solidly upon the fact that to provide a given service, a definite amount of capital must be furnished, and it is not a practical feature that the owners would promptly withdraw a part of this investment at the incipient stages of operation. History tends to show that during the early period the rates could not be made high enough to pay all of the operating expenses, together with the carrying charges and still promote the development of the business. Possibly there may be some exceptions to this rule, but they will be quite rare. In addition, it is a well known story that during the early life of the utility its worth declines steadily with age (barring replacements) while the service value will for a long period remain unaltered. However, after a certain stage has been passed (allowing that the property is not adequately maintained) the property value will be less noticeably affected than the service value, which will drop off sharply. And it is no more than fair to look upon the situation as being a case of low maintenance requirements when the property is new and the earning power small, and heavy repair and replacements when the property has grown older and its earning capacity more fully developed. These circumstances tend to cause a rather even flow of return upon the initial investment through all periods. *But still more important, the utility service is continuous in its scope, which carries with it the obligation to replace any or all parts of the property in order to preserve the*

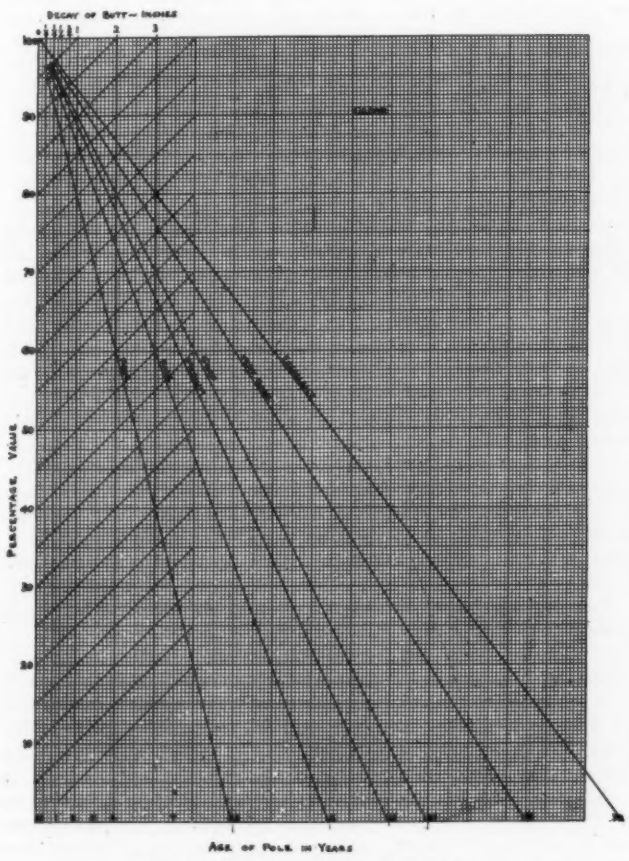


Fig. 5.—Depreciation of Cedar Poles.

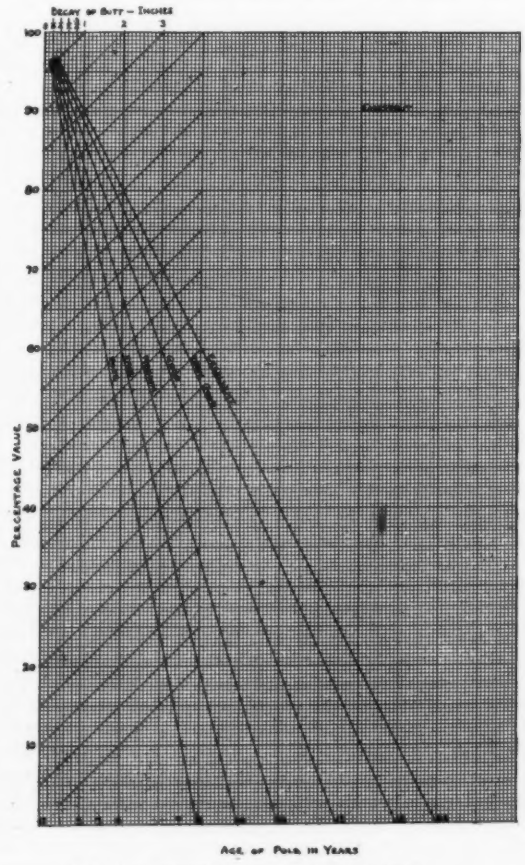


Fig. 6.—Depreciation of Chestnut Poles.

2 A. C. Humphreys, James E. Allison and others.

required standard of service. It plainly becomes a direct responsibility upon the owners, which if disregarded will eventually act to their serious disadvantage.

As has already been pointed out, a certain stage will be reached, if the upkeep is neglected, where the service will not only be exceedingly unsatisfactory and undependable, but will in all probability be refused. Several things may happen in this event, and to facilitate the illustration we will assume that competition is finally introduced and the entire business thus lost when the property still possessed a remaining value (due allowance for salvage) of 33 per cent of the cost new, which is not an unreasonable assumption and which remaining value would become a virtual loss. Accordingly, the owner or owners must hold themselves in readiness to provide for all expenditures where and when necessary to restore the property in whole or in part to its original condition, and consequently are justly entitled to earn a fair return upon not only what represents their capital outlay, but the proportionate risk they constantly carry. To obviate unduly restricting the private initiative, the application and employment of the reserve funds also should within reason remain within the province of the management, subject of course to any restraint the commission may deem it best in the interest of the public.

With more light continually directed upon the subject, it is earnestly hoped that the attitude of our tribunals controlling rates will be led to rationally conform to such business aspect.

It was emphasized in one of the celebrated rate cases that the situation, both economically and ethically, had never been made sufficiently clear. By persistently striving for entire equity the fruition of much creditable work is slowly being reflected in recent decisions of some of our state commissions, as shown in the following.

In an interurban-railway fare case, in determining the value of the utility company's property, the Connecticut Commission, in the case of Herbert O. Bower, *et al.* versus the Connecticut Company, opined that:

"We do not think that the original cost of construction, whatever that may have been, the price paid for the line by the Connecticut Company, whether exorbitant or otherwise, or any inflated value for the issue of stocks or bonds are proper standards to determine the value of the plant and equipment for which the company is entitled to receive a fair income, but that the *cost of reproduction at the present time* in this particular case is a more accurate standard and the one which the Commission has followed in determining such value."

As to be understood, a certain amount of depreciation had accrued, but this was not deducted from the amount of capital upon which the owners were entitled to receive adequate returns, but the Commission definitely held that "What was needed is not change in fares *but improvements in service,*" thus making it incumbent upon the owners to rehabilitate the property, the funds for which the stockholders must provide or forego certain future dividends if proper arrangements for renewals and replacements were not made in the past when the opportunity may have been easily afforded them.

In like respect, the Massachusetts Public Service Commission has primarily considered the fair investment made by the owners, as expressed clearly in the Middlesex and Boston rate case in the following language:

"We rule that on the present rate application the Middlesex and Boston is to be dealt with as a single company. But this ruling is not to be construed to prevent the Commission now or at any time from dealing with the soundness and prudence of any investment made, either by a consolidated company or by any of its constituent companies, when the soundness and prudence of such investment is a material question to be determined in reaching a proper conclusion as to a fair rate. It is only *money honestly and with reasonable prudence invested in a public utility* that is *entitled to earn a full return.* If the Commission finds a street railway company investing money in building extensions contrary to the dictates of reasonable prudence and sound business judgment, it is its plain duty to refuse any, or at any rate a full return upon such investment."

A number of other citations could be made, but these of recent day should be indicative of the tendency of ruling opinion on the subject. The appraiser and owner should always keep these conditions before him *as the safe-guarding* of these matters are just as important in preserving *the equity* in the property as the correct establishment of all construction costs.

Appropriate in this connection is the term "latent depreciation" which "is an expressive term because the loss in value is latent only and does not become potential for any part of the plant until the day for renewal of that part arrives and when that day comes the part is renewed and the liability therefor is cancelled."

(To be continued.)

Pittsfield Section Meeting.

The Pittsfield Section, American Institute of Electrical Engineers, held its annual banquet at the restaurant of the General Electric Company, Pittsfield, Mass., February 24. Dr. W. L. Tracy gave an illustrated lecture on conditions in Europe just before the war. About 125 members were present.

The Principles of Vision.

The Chicago Section of the Illuminating Engineering Society held a meeting in Chicago on February 25, at which Dr. Nelson M. Black, of Milwaukee, Wis., presented an illustrated paper entitled "A Résumé of the Physical, Physiological and Psychical Phases of Vision." This paper was a comprehensive and classical review of the fundamental principles of human vision. The structure of the eye was described and illustrated and the known function of each part explained. Dr. Black reviewed the various theories now held as to the manner in which retinal images are converted into mental sense impressions of brightness, form and color, through the medium of photochemical and nerve tissues. There is still considerable conjecture as to the exact energy transformations involved in this process.

Participating in the discussion of the paper were Harry S. Gradle, M. G. Lloyd, A. J. Sweet, J. R. Cravath, Mr. Trautman and Dr. Black. Dr. Gradle said that the eye is usually found to be more or less imperfect, but slight imperfections are easily taken care of by persons in normal health. Poor illumination or poor visual environment has a great effect on the nervous system and entire well being of the individual. Dr. Lloyd pointed out that the anatomy of the eye is evidently known, but the actual mechanism of visual perception is still problematical. After images, optical illusions, etc., complicate the problem. The eye is probably depended on too much as a source of sense impressions. Mr. Sweet referred to the extraordinary increase in the use of the eye during the past century and the great strain on the eye muscles resulting therefrom. The results of improper illumination are seen in ocular discomfort, decrease in visual acuity and eye fatigue. The illuminating engineer must learn how to give proper weight to these three elements. Mr. Cravath said that excessive muscular strain, as from continued change of focal adjustment, affects some persons much more than others, consequently the exact cause or causes of eye fatigue seem to be as yet undetermined. Mr. Trautman spoke briefly of a new spectacle glass that has the property of cutting off both ultra-violet and infra-red radiation.

In closing the discussion Dr. Black said that most optical illusions belong to the uncertain psychological phases of vision. The assertion that eye troubles are rapidly growing is probably not warranted by the facts. Ocular discomfort, while it may not affect acuity directly, does affect the ability to work in general. Eye fatigue of practically all kinds is due to strain of various eye muscles; there is no evidence that the retina or optic nerve structure has elements sensing pain.

GLARE AS A FACTOR IN STREET LIGHTING.

By Arthur J. Sweet.

During the summer of 1914 an extensive research into the question of glare as a factor in street lighting was conducted at Madison, Wis. The work was carried on under the direction of the Wisconsin Railroad Commission with the very close and valuable co-operation of the electrical engineering department of the University of Wisconsin. The research was under the immediate charge and direction of John N. Cadby, of the Railroad Commission of Wisconsin; Edward Bennett, professor in the University of Wisconsin; and Arthur J. Sweet, of the consulting engineering firm of Vaughn, Meyer & Sweet.

The three engineers having in joint charge the research herein reported on have not, as yet, made any attempt to formulate conclusions from the research which can be subscribed to as joint conclusions. In his analysis of the test results, and in the application of these results to practice, the author therefore speaks for himself alone, and not as committing his associates in the research to the conclusions herein expressed.

In the research herein reported upon, no attempt was made to study "glare" with respect to the discomfort element. The research was confined to an investigation into the factors upon which the blinding effect of street lamps depends, into the magnitude of this blinding effect, and into practical means by which the blinding influence might be minimized to a satisfactory degree.

Experiments were made on an approximately level street of the campus at the University of Wisconsin. Poles with brackets at various heights were erected at proper points so that any one of the several types of installation shown in Fig. 1 could be obtained. Tests were made on various types of lighting units at various heights, as set forth in the accompanying table. In all cases the arrangement of units along the street was such as shown in Fig. 1 for the corresponding height.

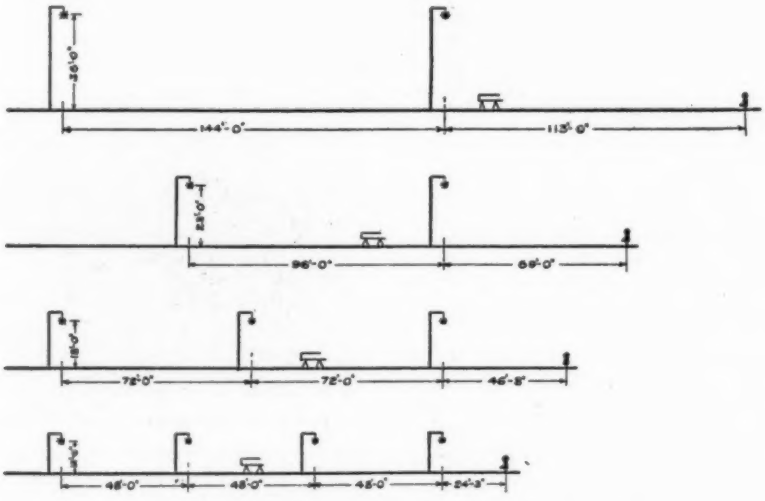


Fig. 1.—Arrangement of Lamps, Subject and Test Object.

Test Method.

At the outset, the investigators were confronted with the necessity of deciding upon some basis by which the blinding effect of street lamps could be measured. After due consideration, the basis proposed by Sweet[1] in 1910 was adopted. According to this basis, the blinding effect of street lamps is measured in terms of the per-cent additional illumination required to give equal clearness of vision, as compared with fixed conditions under which blinding effect was entirely absent.

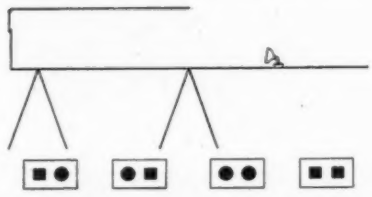


Fig. 2.—Type of Test Box and Test Card.

The actual test procedure was as follows. A group of observers, ten or more in number, were stationed at such point that the line from the observer's eye to the nearest street lamp made an angle of 75 degrees with the vertical (see Fig. 1). One hundred feet from these observers a test box, such as is illustrated in Fig. 2, was placed. This test box consisted essentially of a long box, painted black inside and open only at one end, with a window at the opposite end. The box being so long and being black inside, no light from the street lamps could fall upon that portion of the box where the rear window was located. Test cards of the four types shown in Fig. 2 were exposed one at a time in irregular sequence at the window, each card being exposed for a two-second period, a rest period of six seconds elapsing before the next card was exposed. The black squares or circles on the test cards were suffi-

Object of Research.

The term "glare" has not as yet been exactly defined by illuminating engineers. As generally used, it implies either or both of two separate phenomena. In the presence of a brilliant light shining more or less directly into the eye, the observer senses a distinct feeling of discomfort. This feeling of discomfort is sometimes chiefly in mind when the term "glare" is employed. On the other hand, with a light of high candlepower shining into the observer's eye, the ability of such eye to see—that is, to distinguish contrasts—may be materially reduced. This influence tending to partially blind the eye is sometimes what is meant when the word "glare" is used. More generally, however, the term "glare" has been taken to mean both the discomfort and the decreased ability to see, assuming that the two conditions necessarily go hand in hand.

TYPE OF LIGHT UNIT.	Height in Feet Above Street at Which Light Units Were Tested.
80-candlepower, 6.6-ampere series gas-filled lamp, with Holophane reflector-envelope unit No. 591	12, 18
80-candlepower, 6.6-ampere series gas-filled lamp, in 14-inch Alba ball	12, 18
80-candlepower, 6.6-ampere series gas-filled lamp, with flat enameled metal "radial-wave" reflector	12, 18, 23
80-candlepower, 6.6-ampere series gas-filled lamp, with prismatic refractor-unit No. 4438	12, 18, 23
400-candlepower 6.6-ampere series gas-filled lamp, in 14-inch Alba ball	12, 18, 23
600-candlepower 6.6-ampere series gas-filled lamp, in 14-inch Alba ball	18
600-candlepower 6.6-ampere series gas-filled lamp, used bare without equipment	18
6.6-ampere luminous arc with light-density opal diffusing globe	23
6.6-ampere luminous arc with clear globe	18, 23
6.6-ampere flame carbon arc, opal globe	18, 23, 36

[1] See *Journal of the Franklin Institute*, Vol. CLXIX, No. 5, "An Analysis of Illuminating Requirements in Street Lighting," by Arthur J. Sweet.

ciently large so that, under conditions of normal daylight illumination, the character of the card could be very easily distinguished at the test distance of 100 feet. In front of the box was located a lamp in a metal reflector, so adjustable that any desired illumination could be thrown upon the test cards, while no direct light from the lamp or reflector was permitted to shine toward the observer's eye.

With the apparatus in position and the observers ready to begin the test, the street lamps were thrown off and the street left in darkness. A period of ten minutes or greater was then allowed to elapse in order to let the observers' eyes accommodate themselves to the darkness. After the observers had faced the non-illuminated street for at least ten minutes, a low illumination, furnished by the test-box lamp, was thrown upon the window at the back of the test box, and 15 expo-

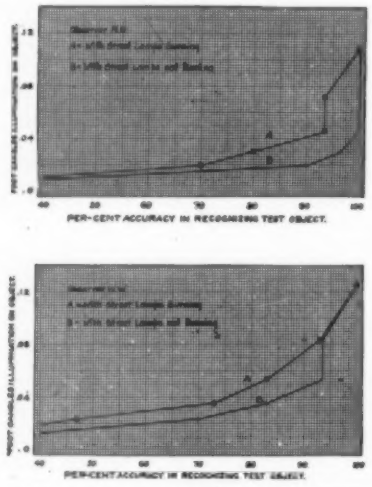


Fig. 3.—Curves of Individual Observers.

400-Candlepower Nitrogen-Filled Lamps in Light-Density Opal Balls. Mounting Height, 18 Feet.

sures of the test cards were made, the cards being selected in irregular sequence. As a card dropped into view at the window, remained two seconds, and then dropped out of view, each observer watched attentively and then, in the six-second rest period, recorded his judgment as to whether the card bore "circle on the right," "square on the right," "two circles," or "two squares." A "zero" was recorded in case the card appeared so indistinct that the observer was unable to identify the card without a large element of guesswork.

The illumination on the card for this first series of fifteen exposures was chosen at such a point that the average observer would get a percentage, in ratio of correct judgments to total exposures, of somewhat less than 50 per cent. In other words, in this first series of exposures, the average observer could not correctly identify more than seven out of the fifteen exposures.

The illumination upon the window was now increased, the street lamps still remaining extinguished, and a new series of 15 exposures of the test cards was made. This time, possibly, the average observer would make 60 per cent correct judgments. Thus by successive steps the illumination upon the window was increased, 15 readings being taken at each step, until, finally, the average observer was able to distinguish the test cards to a percentage of correctness greater than 90 per cent. It proved not to be practical to get results where the average observer showed 100-per-cent correctness of discrimination, as two seconds' inattention on the part of a single observer would bring the average below the 100-per-cent point; and experience showed that, out of so large a number of observers, certain ones would grow careless as soon as the illumination on the card became bright enough to permit the character of the card to be easily distinguished.

Derived from the various series of exposures described above, curves can now be drawn for each individual observer. The B curves of Fig. 3 present such curves for two actual observers. At any given intensity of illumination on the test card, the observer can identify the cards in a series of exposures to some fixed percentage of correctness. Hence we can plot "foot-candles illumination on test object" against "per-cent correctness in identifying object," and obtain a definite curve for any particular observer.

By averaging the individual curves of all observers, we obtain curve B of Fig. 4. Curve B shows how much illumination on the test card the average observer requires, when facing non-illuminated surroundings, to identify the test card to any given percentage of accuracy between 50 and 90 per cent, inclusive.

Curve B (Fig. 4) really measures the efficiency of the average eye under fixed and easily reproducible conditions.

After completing the various series of exposures described above, the street lamps were turned on and a period of at least five minutes allowed for accommodating the eye to the changed lighting conditions. Similar series of exposures were then run, starting with a low illumination on the card and a correspondingly low accuracy on the part of the average observer in correctly identifying the card, and gradually increasing to a higher illumination on the card and a correspondingly high accuracy on the part of the average observer in correctly identifying the card. These various series of exposures, made with the street lamps burning, give data from which the individual curve for each observer (see curves A, Fig. 3) can be plotted. Such curves measure the visual efficiency of the given observer under conditions when the street lamps are burning. Averaging the individual curves as before, curve A, Fig. 4, is obtained.

As a matter of wise procedure, the second group of tests with the street lamps burning was repeated in a third group, the conditions of test being in all respects identical. A fourth group of tests, with the street lamps off, duplicated the first group, which first group has been above described at length. By averaging together the first and fourth groups, and the second and third groups, respectively, any possible influence of fatigue upon the observers was eliminated from the results.

Let us consider what such a complete cycle of test exposures gives in the way of data applying to the sub-

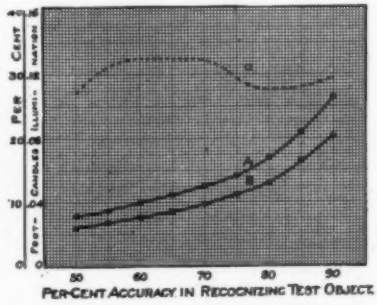


Fig. 4.—Average Results for 19 Observers.

Curve A Gives Required Illumination on Object When Street Lamps Are Burning; Curve B, When Not Burning; Curve C, Ratio of A—B to B. Conditions Same as in Fig. 3.

ject. Referring to Fig. 4, we see that the average observer requires, for any given degree of accuracy in identifying the test object with the street lamps not burning and the eye, therefore, exposed to no conditions of glare, a certain intensity of illumination. With the street lamps burning, the same average observer requires a materially higher degree of illumination to identify the same object to the same degree of accuracy. If, now, the required additional illumination (ordinate A minus ordinate B) be divided by the amount of illumination required by the observer to see under conditions of no glare (ordinate B), we obtain a percentage curve, designated in Fig. 4 as curve C. This curve C shows the per-cent increase in illumination required upon the object to see it equally clearly as compared with what would be required if the eye could be shielded from all external light except that reflected

by the test object itself into the eye.

To illustrate: in the particular test graphically presented by Fig. 4, the average observer required an intensity of illumination on the test card of 0.038 foot-candle, or somewhat brighter illumination than that of full moonlight, to see the cards sufficiently well so as to identify them to an accuracy of 70 per cent correct. This was with the street lamps not burning and hence sending no light into the observer's eye to blind him. When, now, the street lamps were turned on, 0.050 foot-candle was required to see the cards equally clearly. In other words, 0.012 foot-candle additional illumination had to be provided in order to see the cards as clearly as before. This additional illumination is a direct measure of the blinding influence of this particular installation of street lamps. It will be found generally more convenient to express this required additional illumination as a per-cent value: dividing 0.012 by 0.038, we obtain 32 per cent. In other words, 32 per cent additional illumination had to be provided to offset the blinding influence of the street lamps and to permit the object to be seen with equal clearness.

This method of measuring the blinding effect of a street-lighting installation affords at once a very practical and a very easily understood basis. It measures blinding effect directly in terms of the additional illumination required to neutralize it, and hence on a basis which can readily be converted into additional energy or additional cost.

A detailed study of the test data indicates that curve C, Fig. 4, is most accurate between 50 per cent and 90 per cent. The maximum value of any such percentage curve between these two points was therefore taken as the measure of the blinding effect given by any particular type of installation in question. Thus the blinding effect of the 400-candlepower, gas-filled tungsten lamp in opal ball, mounted 18 feet above the street (see Fig 4), was taken as 32.5 per cent.

Analysis of Test Results.

The blinding effect of each installation tested, measured as defined above, was plotted as shown in Fig. 5. A study of these data showed that curves following the general formula

$$y = K \sqrt{x}$$

gave a close approximation to fulfilling the various individual values derived from the test, where

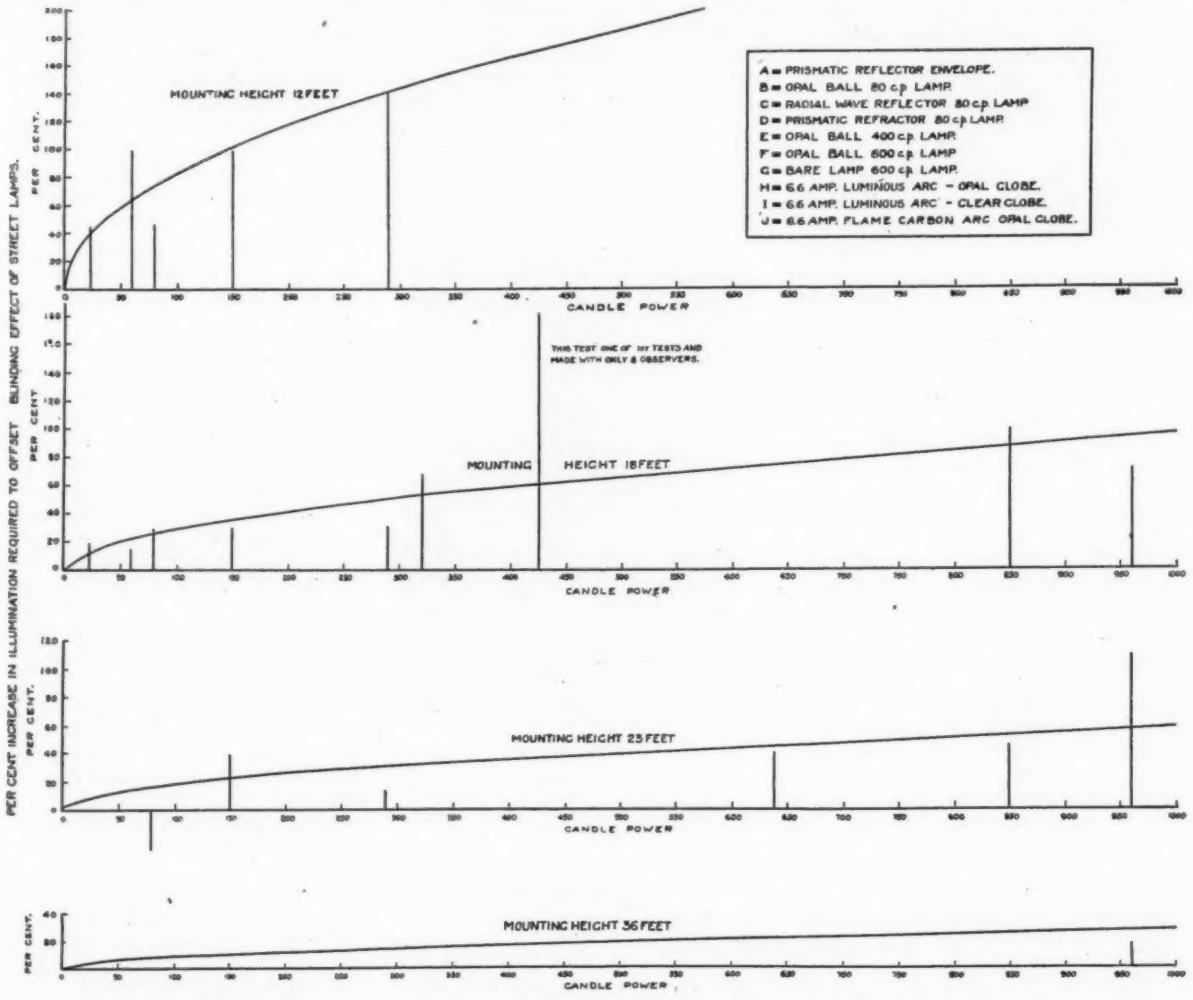

A = PRISMATIC REFLECTOR ENVELOPE.
B = OPAL BALL 80 c.p. LAMP.
C = RADIAL WAVE REFLECTOR 80 c.p. LAMP.
D = PRISMATIC REFRACTOR 80 c.p. LAMP.
E = OPAL BALL 400 c.p. LAMP.
F = OPAL BALL 600 c.p. LAMP.
G = BARE LAMP 600 c.p. LAMP.
H = 6.6 AMP. LUMINOUS ARC - OPAL GLOBE.
I = 6.6 AMP. LUMINOUS ARC - CLEAR GLOBE.
J = 6.6 AMP. FLAME CARBON ARC OPAL GLOBE.
MOUNTING HEIGHT 12 FEET
MOUNTING HEIGHT 18 FEET
MOUNTING HEIGHT 25 FEET
MOUNTING HEIGHT 36 FEET
CANDLE POWER
PER CENT INCREASE IN ILLUMINATION REQUIRED TO OFFSET BLINDING EFFECT OF STREET LAMPS.
PER CENT.

Fig. 5.—Curves of Blinding Effect for Different Heights of Mounting, from Experimental Data.

y = blinding effect of the entire installation, measured in per-cent increased illumination required for equal clearness of vision;

x = average candlepower emitted by a single typical light unit between 75 degrees and 85 degrees from vertical;

and

K = a constant depending upon mounting height.

It is therefore believed that the above formula represents, while probably not the exact relations obtaining,

at least a close enough expression of the law of blinding effect to afford a satisfactory basis for practical procedure in designing street-lighting installations.

The true and exact formula is undoubtedly somewhat more complex than the approximate formula presented above. For instance, the above formula does not take into account whether the lamps are spaced near together or far apart. Extreme variations in spacing values do unquestionably influence to an appreciable amount the degree of blinding effect. Spacing value is, however, a much less important factor in determining blinding effect than either mounting height or candlepower in the 75-85 degree zone; and a detailed study of the more than 90,000 readings taken in the course of the research affords what is believed to be ample evidence that the approximate formula given above can safely be accepted as a basis for practical work until the true formula has been determined to a closer approximation by further research.

A study of Fig. 5 cannot fail to impress the student of street lighting with the very serious degree of blinding effect given by low-mounted street lamps. Thus, at a mounting height of 12 feet above the street, a light unit emitting only 100 candlepower in the 75-80-degree zone blinds the eye to such an extent that approximately 85 per cent more illumination, and hence more electrical energy, is required than would be required if the blinding effect could be avoided. Few installations of cluster lighting carry the lamps more than 12 feet above the street surface, and in most cases the entire cluster, considered as it should be as a single light unit, gives greater candlepower than 100 in the 75-80-degree zone. It is very safe to say that the average installation of cluster lighting blinds the eye to such a degree that materially more than twice as much wattage is required, as compared with what would be required under conditions in which blinding effect was avoided.

From the data given in Fig. 5, the curve of K values (see Fig. 6) for the formula

$$\text{Blinding effect} = K \sqrt{\text{candlepower}}$$

was plotted. In deriving this curve, the K value corresponding to a 36-foot mounting height was not computed from the test data, since only one installation was tested at this mounting height. That portion of the curve between 12-foot and 23-foot mounting heights inclusive was, however, rather accurately determined, as in all approximately 75,000 separate, individual readings were taken upon which this portion of the curve is based. The shape of the full-line portion of the curve of Fig. 6 is such as to quite definitely fix the trend of the dotted portions, of those portions applying to mounting heights less than 12 feet and to mounting heights greater than 23 feet: so that there is not much latitude for error in assuming the dotted portions of the curve as they have been assumed in Fig. 6. Moreover, the results obtained by Sweet in 1910, analyzed in the light of this research, give a K value of 35 for six-foot mounting heights; that is, for mounting heights, where the light unit is directly in the line of vision. It will be seen that a K value of 35 at six-foot mounting height would be in close agreement to the value obtained by extending the curve of Fig. 6. This is strong corroborative evidence that the assumed portion of the curve for mounting heights less than 12 feet is a very close approximation to the true curve of relationship. It is believed, therefore, that this curve of K values, in conjunction with the formula given above, affords a highly valuable and sufficiently reliable basis for determining the seriousness of blinding effect under any given condition of installation in street lighting.

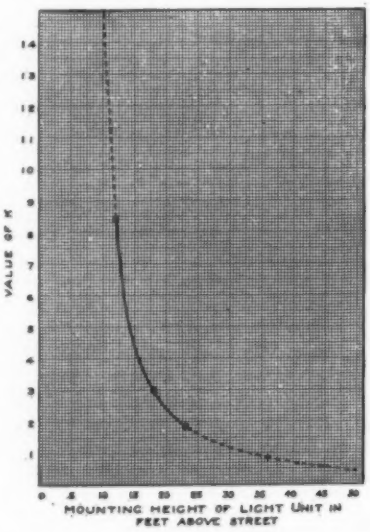


Fig. 6.—Values of K.

Blinding Effect=K $\sqrt{\text{candlepower}}$ (average for 75-85-Degree Zone.)

It is interesting to note that, on the whole, the curve of Fig. 6 bears out the observations of illuminating engineers on the subject of mounting heights. Illuminating engineers have been in general agreement that street lamps of moderate candlepower should not be mounted at a lesser height than 20 feet, and that lamps of high candlepower should not be mounted at a lesser height than 25 feet. Fig. 6 justifies and explains this engineering judgment. It will be noted that, as mounting heights lower than 20 feet are employed, the degree of blinding effect increases quite rapidly; and that, for mounting heights less than 15 feet above the street surface, the blinding effect increases enormously as the mounting height is decreased. On the other hand, as mounting heights greater than, say, 40 feet are employed, there is a relatively small decrease in the degree of blinding effect. Probably few engineers, even among those who have given a notable amount of study to this subject, have realized how serious a practical factor is this element of blinding effect, particularly at the lower mounting heights. Nevertheless, the general nature of the data, first quantitatively established by the research here reported, has for some time been recognized by the non-quantitative observations of students in the field of street lighting.

In addition to the data reported on above, certain interesting excursions into the by-paths of the subject were essayed by the investigators. Chief among these was the determination as to the relative amount of blinding effect which might be exerted by the street lamps and by light reflected from the illuminated surroundings. It was established by ample data that street surroundings, under an average brightness of illumination typical of present-day street-lighting practice, increase rather than decrease the capacity of the eye to see. In other words, the blinding effect comes entirely from the street lamps themselves, and is somewhat more serious than will be indicated by measurements made against the condition of the eye in the darkness. It was chiefly for this reason that the maximum value of curve C (Fig. 4), rather than the mean value, was taken as the measure of the blinding effect.

The investigation very conclusively established that the blinding effect of street lamps was not to be avoided by inclosing the lamp in a diffusing globe. The two phenomena referred to at the opening of this article are sharply independent. Ocular discomfort depends upon the intrinsic brilliancy of the light source in the direction toward the eye, and upon the contrast of this source with its background. Blinding effect depends not at all, or at least not to any important degree, upon the brilliancy of the light source or upon the contrast of the light source with its background. The data of the research upon the above point are so extensive and conclusive that, when they have received full publicity, they should put an effective end to the idea that blinding effect of street lamps can be avoided by inclosing same in opal or white-glass diffusing globes.

Expressed in general terms, blinding

effect is chiefly conditioned by the total candlepower emitted by each light unit toward the eye; by the angle with the line of vision at which the beam from each light unit enters the eye; by the distance of each light unit from the eye; by the number of light units; and by the interrelation of these factors, the proportionate degree of blinding effect which any single unit exercises in conjunction with others being materially less than that which it would exercise in the absence of others, conditions otherwise being identical. Expressed concretely, in terms more directly related to practice, blinding effect depends upon the candlepower of the street lamp at all various angles in the 65-90-degree zone, but particularly in the 75-85-degree zone; upon the mounting height of the lamp; and—but to a decidedly less degree—upon the closeness of spacing of the lamps.

It may be inquired as to how blinding effect may be avoided if it is desired to employ relatively low mounting heights. The research here reported upon gives much evidence substantiating the conclusions of Sweet upon this subject, as determined by his 1910 research above referred to. In brief, these conclusions were that for a total elimination of blinding effect, the lighting unit must emit zero candlepower between the angles of 65 degrees and 90 degrees from the nadir. This 1914 research indicates conclusively that to reduce blinding effect to a satisfactory minimum at low mounting heights, the light emitted by the unit between the angles of 75 degrees and 90 degrees from the nadir must be practically reduced to zero.

Another interesting and highly important fact brought out by this research (data not here presented) is that the more distant light unit, say the one whose 85-degree ray reaches the eye, induces a more serious degree of blinding effect than the nearer light unit, whose, say 75-degree ray reaches the eye. In other words, distance, at least within wide limits, is a less important factor than is angle of blinding beam in determining the degree of blinding effect. This fact, taken in conjunction with the other data of the research, justifies the statement previously made that "spacing value is a much less important factor in determining blinding effect than either mounting height or candlepower in the 75-85-degree zone."

The fact that blinding effect is more largely conditioned by the more distant lamps than by the nearest lamp, and the further fact that the combined blinding effect of nearest and of more distant lamps is materially less than the arithmetical sum of either blinding effect taken alone, establishes that unless the spacings are extremely long, blinding effect is approximately constant at all points along the street, whatever the position of the observer with reference to the nearest lamp.

With such a large amount of data as was obtained in the research here reported upon, it has been impossible within proper limitations of space to give more than a description of the test method and a statement of the conclusions to be derived from the data. Because of this impossibility of presenting and of analyzing in detail all the evidence upon which the conclusions are based, some of the conclusions may seem to be too sweeping. It is believed that the conclusions, sweeping as some of them may be, are fully established by the evidence at hand. To any who care to address him, the author will be glad to furnish in private correspondence the evidence with respect to any conclusion which seems doubtfully established by this presentation.

It is probable that in the not distant future the complete data of the research will be published in a bulletin by the University of Wisconsin.

Summary of Conclusions.

The Madison research establishes to a high degree of probability:

(1) That ocular discomfort and blinding effect, generally considered as different manifestations of the same phenomenon and grouped together under the term "glare," are really separate and independent phenomena.

(2) That, while ocular discomfort can be tremendously reduced by surrounding a brilliant light source with a diffusing globe, blinding effect cannot be materially reduced by such means.

(3) That blinding effect may be, under certain conditions, such a serious factor in street lighting that its due consideration can no more properly be neglected than can the consideration of light-generating efficiency in the selection of the light unit.

(4) That so far as other considerations permit, mounting heights less than 20 feet should be avoided, and that in no case should mounting heights less than approximately 15 feet be employed.

(5) That, when other considerations outweigh that of blinding effect, and it becomes desirable to employ relatively low mounting heights, the type of light unit selected should be such that the candlepower values between the angles of 65 degrees from the vertical and 90 degrees from the vertical are relatively low.

(6) That mounting heights greater than approximately 50 feet cannot be justified from the standpoint of avoiding blinding effect.

(7) That, until a more accurate expression of the true relationship be derived, the approximate formula

$$\text{Blinding effect} = K\sqrt{\text{candlepower}}$$

where K is obtained from the curve of Fig. 6, is a sufficiently accurate guide for the study of blinding-effect magnitudes and relationships in actual street-lighting practice.

Electrolysis in Springfield.

The United States Bureau of Standards has made a survey of the subject of electrolysis in Springfield, Mass. In the report, issued February 26, it is recommended that the Springfield Street Railway Company abandon its steam generating plant on Margaret Street and substitute four substations, three in Springfield and one in West Springfield, and buy alternating current from the Amherst Power Company, which secures its electrical supply from water-power plants at Turners Falls and Greenfield.

This change would provide shorter circuits and result in the saving of much of the present loss of energy. It is suggested that the present direct-current station be secured as an auxiliary by the hydroelectric company.

The electrolysis investigation was begun last spring, the cost being borne by the telephone, gas and electric light companies and the water department. The preparation of the report was at the expense of the Bureau of Standards. The street railway company aided by making electrical measurements and supplying information in regard to the physical plant of the company.

A careful study was made of power distribution in Springfield, and estimates of costs were formulated under three heads: (1) cost of supplying power under present conditions; (2) through the medium of four substations; (3) from the present direct-current plant with insulated feeders; (4) from two substations with supply from the present generating plant.

The plan suggested was decided to be the most economical and feasible, as well as doing away with conditions resulting in electrolysis.

Legislation May Force Electrification in Boston.

The electrification of all standard-gauge railroads within the metropolitan district of Boston is the subject of proposed legislation by the Legislature of Massachusetts. At a hearing February 25, Senator Sullivan of Boston pointed out the "intolerable conditions" existing on the south side of Boston, where about 900 locomotives enter and leave the South terminal daily.

Officials of the New Haven, Boston & Albany and Boston & Maine Railroads opposed the bill on the ground of lack of available funds.

Minneapolis and St. Paul Jovians Hold Joint Rejuvenation.

The joint rejuvenation and joviation of the St. Paul and Minneapolis Jovian leagues February 26, was the principal event of last week for the electrical men of the Twin Cities. It was the first of a series of meetings by which the members of the two organizations hope to become better acquainted with one another and, by fusing their influence to some extent, to become a more active factor in the developing and maintaining of a high standard for the electrical business in this territory.

The meeting was held at the St. Paul Commercial Club rooms, St. Paul. It was opened by Clovis M. Converse, Tribune of the St. Paul League, who introduced W. T. White, Tribune of the Minneapolis League, as toastmaster of the evening. Mr. White responded with a speech that had the kind of "punch" in it that makes a Jovian audience sit up and think seriously. His plea was mainly for efficiency in the leagues. As workmen in their own lines of business, he said, the Jovians have a good record. But when it comes to the advancement of the interests of the Order there is the inevitable inclination to shift the burden to the few in authority. If the members would only work as hard in the interests of the league as they do in their private business, Mr. White believes they would soon realize that the results amply repaid their efforts. He emphasized strongly the value of "the get-together spirit," and the need of every man looking upon the interests of the Order as his own personal interests if the best results are to be attained.

A. L. Ricard, of the Metropolitan Engineering Company, New York, was one of the guests of the evening, and extended the greetings of the New York Jovians to their western brothers. He described at some length the work of the New York League. R. L. Price, Chicago representative of the Robbins & Myers Company, and formerly Jovian statesman of Nebraska, made a plea for constructive publicity for the electrical trades. This, he said, could be accomplished through the Jovian leagues of the country, and would result in an immense benefit to electrical trades generally.

Mr. Price pointed out that a convenient and popular way of "explaining" the origin of fires the causes of which are in doubt, is to say that they were due to the crossing of electrical wires. This has become so common that it is habitual, notwithstanding that it is an injustice seriously detrimental to electrical men. He advised the Jovians to take it upon themselves to challenge statements of this kind loosely made, and demand to have them proved or withdrawn. A campaign of this kind would start the offenders thinking and soon eliminate the abuse.

F. A. Otto,, superintendent of the St. Paul Gas Light Company, described the work of the St. Paul Jovian League, and complimented it on its achievements. Leo H. Cooper, National Argus of the Jovian Order and chairman of the Minnesota Section of the American Institute of Electrical Engineers, pointed out what the Jovians can do for the contractors. Electrical contractors, he said, could do nothing better than use the Jovian leagues as a medium for getting together. They could discuss their business problems calmly and without prejudice, and instead of indulging in reckless cut-throat competition, should agree on rates that will give them a merited return for their labor and risks.

The degree work was put on by the Minneapolis degree team which was highly complimented by the remarks on the part of many of those in attendance that it was the best ever exemplified in that section of the Northwest.

At the regular bi-weekly meeting February 23, the Minneapolis Jovians listened to a talk on "Mental Efficiency" by Dr. A. C. Rogers, superintendent of the State School for Feeble Minded at Faribault, Minn.

Census Report on Telephones and Telegraphs.

The quinquennial report on telephones, telegraphs, and municipal electric fire-alarm and police-patrol signaling systems, relating to the calendar year 1912, will soon be given out by Director William J. Harris, of the Bureau of the Census, Department of Commerce. This report, which was prepared under the supervision of William M. Steuart, will show that the amount of telephone wire in use in the United States increased from almost 13,000,000 miles in 1907 to more than 20,000,000 miles in 1912, or by about 54 per cent, while the number of miles of commercial telegraph wire, including ocean cable, increased during the same period from over 1,624,000 miles to nearly 1,882,000 miles, or by 15 per cent.

Statistics as to telephone calls are available only for companies having annual incomes of $5,000 or over. Such companies, which in 1912 operated about 94 per cent of the wire mileage and about 84 per cent of the telephones, reported for that year approximately 13,735,000,000 calls, an increase of about 32 per cent over the number (10,400,000,000) reported for 1907. During the same period the business of the telegraph companies (land, ocean, and wireless combined) increased from approximately 103,949,000 messages to 109,663,000, or by about 5.5 per cent.

The capitalization of the telephone companies with incomes of $5,000 or over increased from $758,000,000 in 1907 to $991,000,000 in 1912, or by more than 30 per cent. During the same time the capitalization of the telegraph companies decreased from $253,000,000 to $232,000,000, or by approximately 8 per cent. This decrease, however, was due entirely to a reduction of $23,000,000 in the capitalization of wireless telegraph companies. Excluding the figures for such companies, an increase in capitalization of $2,200,000, or about one per cent, is shown.

The net income of the telephone companies with incomes of $5,000 or more increased from $41,200,000 in 1907 to $51,300,000 in 1912, or by nearly 25 per cent, while during the same period the net income of the telegraph companies decreased from $9,650,000 to $6,400,000, or by about one-third.

The number of employees reported by telephone companies with incomes of $5,000 and over increased from approximately 131,000 in 1907 to 183,000 in 1912, or by over 39 per cent, while during the same period the number of persons employed by telegraph companies rose from 28,000 to 38,000, the rate of increase being nearly 36 per cent.

The total number of telephones in use (exclusive of railway, governmental, or private telephones not connected with public exchanges) increased from 6,118,000 in 1907 to 8,730,000 in 1912, or by nearly 43 per cent.

The number of telephones per 1,000 population in the entire United States rose from 30 in 1902 to 72 in 1907 and to 91 in 1912. The greatest "telephone density" was found in Iowa, where there were 171 telephones per 1,000 population. California was a close second, with 168, and Nebraska stood third, with 165. The smallest number of telephones per 1,000 population, 21, was found in South Carolina.

The number of messages per capita for the United States as a whole (exclusive of those sent over the lines of companies having annual incomes of less than $5,000) increased from 65 in 1902 to 122 in 1907 and to 144 in 1912. The greatest number of messages per capita during the later year, 282, was reported from California, while Ohio, with 265, and Michigan, with 240, ranked second and third.

There are six ocean-cable companies incorporated in the United States, with 83 cable offices and 44,860 miles of cable. These companies handled 2,845,000 messages in 1912, an increase of 20 per cent over the number for 1907. In addition, the Western Union Telegraph Company operated 22,800 miles of cable and handled nearly 3,000,000 cable messages in 1912.

Wireless Telegraphy.

Between 1907 and 1912 the number

of commercial wireless telegraph companies doing business in the United States decreased from 5 to 4, the number of tower stations from 117 to 74, and the capitalization from $32,700,000 to $9,600,000. The number of messages sent, however, increased from 154,617 to 285,091, or by 84.4 per cent; a net deficit of $53,538 in 1907 was changed to a net income of $4,738 in 1912; the number of employees increased from 176 to 958, or by 444 per cent; and the amount paid in salaries and wages increased from $82,000 to $394,000, or by 380 per cent.

The United States Government maintains 73 wireless stations, a considerable number of which are open for public business.

The number of municipal electric fire-alarm and police-patrol signaling systems increased from 1,157 in 1907 to 1,397 in 1912, or by 20.7 per cent. During the same period the number of miles of single wire increased from 70,800 to 90,300, or by 27.5 per cent; the number of boxes or signaling stations, from 62,500 to 81,300, or by 30 per cent; and the number of fire alarms received, from 120,700 to 175,500, or by over 45 per cent.

Variations in Strength of Wireless Signals.

Prof. E. W. Marchant read a valuable communication on his investigation of the conditions affecting the variations in strength of wireless signals before the Institution of Electrical Engineers in Liverpool, England, on February 9. He said that remarkable distances had been covered at night by using comparatively small power plants. For example, the signals from a boat sailing from Gibraltar to Port Said with a standard 1.5-kilowatt set were received at Liverpool with great clearness on Sunday evening, June 14, 1914, i. e., at a distance of over 1,200 miles. Further investigation was required to secure a complete explanation of freak signals such as this. Theories involving the reflection and refraction of the electromagnetic waves had been developed by Heaviside, Eccles, Kennelly, Erskine-Murray and others, but it was very difficult to express an opinion without experimental data.

Although many records had been taken, very few of these gave actual measurements of signal strength, and it was with a view to securing such information that the author's investigations were undertaken. Their scope was confined to (1) observations of the effects of atmospheric conditions of all kinds on the strength of signals, and for this purpose a series of observations lasting for a year had been made; (2) variations noticeable at sunset in the strength of the signals; (3) observations on fluctuations in the strength of signals during the night. Most of the measurements were made between Liverpool and Paris, which lie mutually almost northwest and southeast. Some results were also recorded in connection with the new station (recently destroyed) in Brussels by Dr. Goldschmidt. The bulk of the work, however, had been done in connection with the Eiffel Tower station.

The results of Professor Marchant's investigations are summarized thus:

(1) Between two stations lying nearly northwest and southeast of each other, the strength of signals during the daytime varies within comparatively narrow limits.

(2) The ratio between the night and day strength varies with the time of the year and also from day to day in any given month, as shown by Mosler.

(3) On a fine clear day the "sunset effect" occurs about three-quarters of an hour after the actual time of sunset and varies with the weather conditions. When rainy conditions prevail, the strengthening of the signal after sunset is much less marked.

(4) The amount of the sunset effect varies with the direction in which signals are emitted.

(5) There is very little evidence that between two stations, such as Liverpool and Paris, where the difference in longitude is about 22 minutes, there is anything in the nature of a dense fog which is opaque to waves, and which causes a drop in signal strength when the dark-light band lies between the two stations.

(6) Variations during the night are relatively great and occur within the space of a few minutes. The greatest increases in strength of signals have been observed after the cessation of rain either at the sending or receiving station.

(7) The character and strength of the variations in signal strength point to the conclusion that the main factor which controls the variations is the state of ionization of the atmosphere, and that it seems likely that clouds of ionized air may exist in the upper regions of the atmosphere which act as mirrors for the waves and cause the sudden changes in signal strength that have been observed; this was suggested by Fessenden in 1907.

Maine Water-Power Bill

Hearings were held last week on the Tracy bill for the creation in Maine of a commission to take over and develop the water powers of that state, noted in our issue of February 27.

Mr. Tracy, the author of the bill, declared that the title to Maine water powers was vested in the people, under a deed granted in 1691 by King William and Queen Mary of England. He said there were 1,800,000 horsepower capable of development in the state, and only 300,000 now utilized. He claimed the cost of steam was $65 per horsepower-year. If the state were to develop the powers and sell the energy produced at $30 a horsepower, an income of nearly $60,000,000 would be possible. Deducting $10,000,000 for riparian rights and $15,000,000 for running expenses, there would remain a net annual revenue of $26.95 per inhabitant.

S. D. Warren, of Westbrook, and W. S. Wyman, of the Central Maine Power Company, opposed the measure. The former held that water power could not be sold profitably at $20 a horsepower, which the bill contemplates. Mr. Wyman said his company has been in existence 25 years and had thus far marketed but 25,000 horsepower. It has a minimum price of $1.25 per horsepower per month, and this is often prohibitive.

Objections were offered on the grounds of the project necessitating expenditure exceeding the state's constitutional debt limit, and the lack of a sufficient market for greatly increased volume of energy over those now used.

New Power Plant for Public Service Electric Company.

The Public Service Electric Company, Newark, N. J., has filed plans for its new electric generating station at Point-No-Point, on the meadows. Two buildings, three and six stories in height, respectively, are to be erected at once; these will embrace a boiler house and steam turbine room, 170 by 250 feet; switch house, 80 by 120 feet; and coal bunker, 43 by 70 feet. The structures will be of brick, steel and concrete, and thoroughly fireproof. The estimated cost of the work is $400,000.

Underwriters' Laboratories to Resume Distributing Circular Information Respecting Fires of an Electrical Origin.

In response to repeated requests, the Underwriters' Laboratories, Incorporated, Chicago, announces that it will again undertake the work of distributing quarterly reports of fires and accidents attributable to the use of electricity, for the benefit exclusively of the subscribers to card reports on electrical devices and materials.

Navy Wireless Equipment.

The ships of the United States Navy are provided with wireless equipment capable of receiving messages without relay at 3,000 miles, and with a sending radius varying from about 400 miles in the daytime to about 1,000 miles at night.

LETTERS TO THE EDITOR.

Concentric Wiring System.

To the Editor:

In connection with the present discussion of the proposed concentric wiring system, the letter by Mr. R. B. Benjamin in your issue of February 20, 1915, is of particular interest, as he seems to have arrived at a solution which should be most acceptable to all interests involved.

The system mentioned in the next to last paragraph of his letter would meet the demands for inexpensiveness to an extent which would not only satisfy the interests of the electric lighting companies, but would also largely, if not entirely, displace the knob-and-tube system.

The system which he suggests was proposed and advocated by the writer about ten years ago, and at one time an effort was made to incorporate rules in the National Code allowing the construction outlined.

A discussion of the proposal appeared in *Electrocraft* about eight years ago with a complete outline of rules.

H. J. BLAKESLEE,
The States Company.
Hartford, Conn., February 24, 1915.

"Permanent and Effective Grounding" of Concentric Wire.

To the Editor:

The writer read with great interest, in a recent issue of one of the trade journals, a list of the tentative rules drawn to govern the installation of concentric wire by the subcommittee of the National Fire Protection Association having the matter in charge, since, in common with many others in the industry, he was particularly anxious to learn what methods the committee had been able to devise to safeguard the prime feature on which concentric systems most certainly must either stand or fall—permanent and effective grounding.

These rules, however, failed to make any provisions which would change the opinion of those who have felt that such grounding would be exceedingly difficult, if not impossible, in many instances, as no particular ground rules were proposed further than a standard requirement.

Inquiry amongst the advocates of concentric systems with relation to this most important factor has also failed of a satisfactory answer, since such inquiries have invariably brought a reply dealing with the wide margin of ground protection afforded by large three-wire secondary systems in which the neutral was frequently grounded, as well as the corresponding leg of each two-wire secondary entrance. There can, of course, be no question but that the multiplicity of grounds so secured constitutes "permanent and effective grounding," but what of the thousands upon thousands of instances where one transformer feeds but one installation, or possibly two or three?

Is it safe to make life and property absolutely dependent upon the grounds obtainable in such cases?

A few hours spent in the inspection of installations of this class in almost any large American city where secondary grounding is already standard practice, will serve to answer this question so effectually as to make even the most enthusiastic advocate of "concentric" pause, and will do much toward convincing him that, regardless of the success claimed for the system in certain sections of Europe, its introduction for us in America is fraught with extremely grave possibilities.

Here, for example, are a few cases selected almost at random from a number of such inspections recently made by the writer in two large cities in which secondary grounding is required by the central stations:

Case 1. Twenty-family apartment. Ground wire to water pipe at service entrance inside building, cut and coiled back during repairs to steam line a year ago. Never repaired.

Case 2. Four-story tenement and grocery. Ground wire at service entrance carried down wall inside building to water pipe in basement, but had been cut away during remodeling of grocery, as it interfered with shelving.

Case 3. Five-story factory and loft building. Ground wire at service entrance carried down outside wall to water pipe in basement, and evidently housed in pipe at time of installation, but had been cut away when package chute was installed a few months ago. Never replaced.

Case 4. Dwelling. Ground wire carried down outside of building, and to water pipe in cellar from service entrance, interrupted by removal of eight-foot section by son of owner, who "needed it for his wireless." He has it still.

Case 5. Dwelling. Ground wire originally carried down outside of building from service entrance to gas pipe in cellar, but removed by painters on order of owner, who considered it "unsightly." Never replaced.

Case 6. Sixteen-family apartment. Ground wire at service entrance connected with steam line and approved by inspector, but useless because metallic path to water main was broken through wooden pressure tank on the roof.

Note: In each of the above cases the transformer fed the individual building only, and the ground referred to was the only one on the service, since it is not customary to ground such services at the transformer, both because of the expense involved and the extreme difficulty of getting a ground at the pole in many instances, due to soil conditions.

It is not stretching a point in the least to say that the cases above are typical, as will be attested by any person familiar with the facts, or by anyone who will take the trouble to investigate carefully. The experience of almost any field inspector, for example, embodies many similar instances, as do the reports of every competent inspector who has had reinspection experience in large towns and cities where secondary grounding has been the practice for any length of time.

In addition to these instances of deliberate or accidental interruptions of established grounds from causes such as cited above, the indiscriminate prejudice of small gas and water companies toward the grounding of anything upon their lines, must be considered, together with the faulty workmanship, which is often responsible for a very indifferent ground, and one which will deteriorate rapidly.

The idea advanced in certain quarters that the inspection departments of the fire underwriters, municipalities, and central stations could govern interruption of grounds on concentric systems by additions to their staffs and by frequent reinspections, borders closely upon the absurd, for it is doubtful if ten times the present number of inspectors could possibly control this condition.

Falling back upon the experience of European users, too, as a sweeping answer to this, and to several other arguments advanced against concentric systems, can hardly be said to clinch the case in favor of the material, since there are too many points in which European and American conditions differ widely. It should be borne in mind, for example, that an approval of concentric wire under our National Electrical Code throws the gates wide open for its use in every city, town, village and hamlet in the country, by the competent and incompetent, and with or without proper inspection, whereas in Europe its use is practically limited to given communities, the electrical affairs of which are dominated by some one corporate interest and installations more or less closely supervised by its employees. A radical difference certainly.

In fact, with all due respect to the advocates of concentric systems, and without the slightest desire to question their good faith, it would seem that the opinion widely held throughout the industry, that they have been led to become its advocates by mentally applying it to more or less idealized conditions in which it assayed a far greater

margin of safety than should properly be credited to it, is sound.

In conclusion, the writer wishes to go on record as believing that if a poll could be taken of the men in the field who would in a large measure be forced to assume responsibility for the safety of concentric installations—men who have first-hand, every-day knowledge of what many householders or mechanics will do to a wire which if in their way, can be cut without "making the lights go out," and who have similar knowledge of the many other things which can happen to a wire as exposed as ground wires usually must be—the concentric idea, or any other dependent solely for its safety upon a ground, would be voted down with a sweeping unanimity.

C. W. Abbott,
American Conduit Manufacturing Company.
Pittsburgh, Pa., March 1, 1915.

International Standardization of Ratings.

The National Illumination Committee of Great Britain, which is constituted by co-operation of the Illuminating Engineering Society, the Institution of Electrical Engineers, the Institution of Gas Engineers and the National Physical Laboratory, held a special annual meeting in London recently. It was reported that the work of the past year had consisted mainly in the establishment of rules and the appointment of officers. The rules represented the unanimous opinion of the representatives of the various interests and it was felt that they formed a good foundation upon which constructive work could be based. The committee had under consideration the question of the rating of light sources in candlepower or consumption, and it has passed the following resolution which has been transmitted to the International Commission on Illumination:

"It is desirable that a uniform international method be adopted for rating and marking all sources of light. It is recommended by the National Illumination Committee of Great Britain that the matter be considered at the next session of the International Commission on Illumination and the administration of that Commission is asked to take the necessary steps to bring this resolution to the knowledge of the different national committees with a view to their co-operation."

The committee also considered the report on nomenclature and standards of the American Illuminating Engineering Society and has appointed a subcommittee to draft sets of definitions and nomenclature for consideration. The war has, of course, had an adverse influence on the international aspect of the work. Although the harmony which had characterized the international conference in the past had been destroyed, it would be possible for the various national committees to make some progress on independent lines and it is hoped that no considerable period of time will elapse before complete harmony is restored.

Polyphase Commutator Machines.

Discussing polyphase commutator machines and their applications, at the Birmingham (England) Institution of Electrical Engineers, N. Shuttleworth referred to the lack of published information on the subject and said that recent developments were of interest to prospective users. His general conclusions were these: Variable-speed motors of the shunt and series types are at present being manufactured in sizes up to 75 horsepower at 50 cycles, and in higher powers at lower frequencies, and in service are giving very satisfactory results. They are not inherently costly and it seems very improbable that any other new type will be forthcoming to render them either cheaper or more simple. Between 75 and 200 horsepower, the types available have a price per horsepower which seems to be prohibitive, if judged by the number in operation. For outputs above 200 horsepower the induction motor with cascade commutator motor is probably the cheapest and best combination.

Examination for Electrical Inspector.

The United States Civil Service Commission announces an open competitive examination for subinspector, electrical, for men only, on April 7, 1915, at the usual places. From the register of eligibles resulting, certification will be made to fill a vacancy in this position at $4.16 per diem, in the office of the Inspector of Engineering Material, United States Navy, Pittsburgh, Pa., and vacancies in positions requiring similar qualifications as they may occur in any United States navy yard or naval establishment, at entrance salaries ranging from $3.60 to $5.04 per diem.

The duties of the position cover the shop inspection and testing of all types of generators, transformers, motors, motor-generators up to 300 kilowatts capacity, together with their controlling apparatus, and the appointee must be capable of making all calculations and deductions connected therewith.

The work of the subinspectors will require travel and temporary location at the various manufacturing plants where Navy contracts are being carried out.

Competitors will be examined in theoretical and practical question and calculations in electricity, training and experience.

Applicants should have two years' training in electrical engineering in a technical school of recognized standing, and in addition not less than two years' experience in general inspection and testing of a character corresponding to the duties.

Persons who desire this examination should at once apply for Form 1312, stating the title of the examination for which the form is desired, to the United State Civil Service Commission, Washington, D. C.

International Engineering Congress.

Vol. 1 of the *Transactions* of the International Engineering Congress will comprise a unique series of papers on the engineering of the Panama Canal. The various topics and subdivisions of the work have been arranged by Col. G. W. Goethals, chief engineer. Colonel Goethals has also selected the author for the treatment of each paper, and he will himself contribute the introductory chapter. The various authors are in general the officers who were in direct charge of the actual work of construction, and the collection of papers thus becomes a first-hand account of the engineering of the Panama Canal, written by the men who were in immediate and responsible charge of the undertaking.

There will be 24 papers in all, profusely illustrated, 22 of which deal with actual constructive and engineering problems connected with the work, one with the preliminary work in municipal engineering in the Canal Zone, and one with the commercial and trade aspects of the Canal.

The *Transactions* of the Congress as a whole will include from seven to nine other volumes, covering all important phases of engineering work.

Membership in the Congress is open to all interested in engineering work. For full particulars apply to W. A. Cattell, secretary, 417 Foxcroft Building, San Francisco, Cal.

Where Telephones Are Most Numerous.

About half the wire mileage and telephones in the United States are found in the eight states of New York, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Michigan and Wisconsin, which together contain about 40 per cent of the entire population of the United States. The greatest wire mileage for any one state in 1912, 2,790,000, was reported by New York, while Illinois stood second, with 1,689,000 miles, and Pennsylvania third, with 1,600,000 miles. In number of telephones New York and Illinois again ranked first and second, with 970,000 and 807,000 respectively, while Ohio occupied third place.

New Electrical and Mechanical Appliances

A New Ground Clamp.

A new ground clamp under the trade name "Ideal" has been placed on the market. It consists of two strips of brass, of different gauge and width. The longer strip is formed at its end with a punched lug, through which the brass clamping screw extends, and has a slot one and one-half by three-eighths inch. The opposite end is narrowed to fit the slot and is bent to form a hook, as shown in the cut. The second strip is formed at one end with a similar lug for the clamping screw and at the other end with a triangular eyelet. When assembled, the hook end of the longer strip is extended through the slot in the opposite end and into the eyelet in the second strip, thus forming a band which fits loosely around the pipe or conduit to be grounded. The shorter strip attached to the end of the first strip is then bent around until the punched lugs are in line, permitting the clamping screw to be placed in position. As the screw is tightened, drawing the ends together, the shorter strip draws the narrowed end of the other through the slot, thus reducing the circumference of the band until it is tightened on the pipe or conduit. A lug for connecting the ground wire is formed on the outer strip, as shown. It is of proper size to receive a No. 4 B. & S. gauge wire.

The clamp closes perfectly round the pipe, thereby insuring a perfect ground in its entire circumference. It will not buckle and can be easily slipped over a pipe, no matter in what position it may be. It always maintains its original shape. These clamps are very easily installed. The inner piece is slipped over the pipe into position. The ground wire is then soldered into the lug on the outer piece. This piece is then slipped into the lip of the inner piece and fastened with the brass screw and nut.

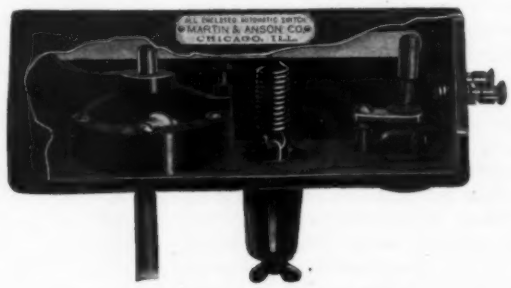
"Ideal" clamps are made of brass, five-eighths inch and seven-eighths inch wide, and in the following gauges, Nos. 20, 18 and 16. Heavier or wider clamps can be furnished either in brass or copper to meet specifications. These clamps are not more costly than other types now available. They are being marketed by Frederick Rall, 19 Park Place, New York City.

Parts of Ground Clamp and Assembled Clamp.

Automatic Pressure-Controlling Switch.

The all-inclosed automatic switch, manufactured by the Martin & Anson Company, 2226 Indiana Avenue, Chicago, Ill., is intended for the control of motor-driven air or water pumps for pressure or vacuum purposes. The operating mechanism is very simple. Changes in pressure are transmitted to levers, actuating the make-and-break mechanism by means of a plunger resting on a flexible diaphragm. The electrical contacts act in a positive, instantaneous manner, thus reducing danger from burning or arcing. The switch therefore is always in working condition.

This switch is made up in twelve sizes and types, thus providing regulation for all ordinary ranges of pressure and vacuum. By inclosing the moving parts with a sheet-metal hood, the danger of irresponsible tampering, or accidental injury is eliminated. Pressure adjustment is made by means of the small thumb-nut at the bottom. The larger sizes of switches are provided with a flange, making them suitable for mounting on a panel.



Automatic Pressure-Controlling Switch.

Diehl Pressed-Metal Fans.

Prominent in the line of electric fans put out this year by the Diehl Manufacturing Company, Elizabeth, N. J., is the assortment of pressed or drawn-metal fans. During the 26 years that the Diehl company has been making fans, it has continually improved its product by incorporating leading ideas in fan design and construction. Its pressed-metal fans are regarded by the company as a distinct achievement in producing an evenly balanced design that gives equal prominence to the important features of efficiency, quiet operation, light weight, adjustability, mechanical simplicity, long life, small power consumption, low maintenance cost and attractive appearance, all of these having been found to be salient points that any fan should possess to give the best service.

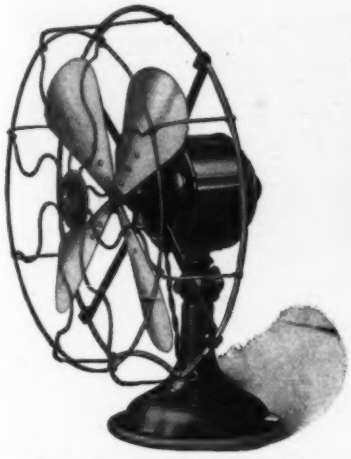
These pressed-metal fans are made in 12-inch and 16-inch sizes with four or six blades for the desk and bracket types; the pressed-metal construction is also used for the 12 and 16-inch four-blade oscillators. Pressed metal is used for the motor yoke ring and end covers and for the supporting stem and base. The thickness of the metal is such as gives reasonably light weight consistent with strength and durability. The metal is gracefully shaped and its smooth surface is given a high black-enamel finish which with the polished brass blades and guard makes the fans very attractive. Secured to the base is a flexible rubber pad that protects polished desks or other furniture from scratching. Angular adjustment, as well as change from upright to wall position, is made by means of a wing nut and ball joint in the stem. The fan body may also be turned about horizontally on a swivel to any desired extent. The guard about the blades has two outer

rings and is amply strong to permit carrying the fan by this means. Each fan has three speeds, each of which is a running speed and is plainly marked. Bakelite is used in all commutator construction to obtain high insulation and to avoid troubles from expansion and contraction due to heating and cooling.

All these fans are made for direct current and for several frequencies of alternating current. All alterating-current fans have induction motors provided with an automatic centrifugal cutout to remove the starting resistance when the fan attains full speed. This construction has been found to be most efficient. The stator and rotor cores are of laminated steel to further increase the efficiency.

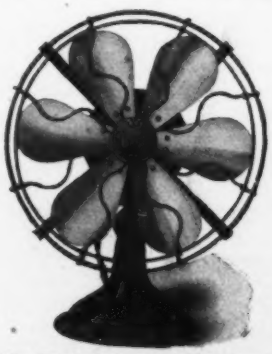
Oscillating fans have worm and gear mechanism, which runs in grease in a closed case that is almost entirely concealed within the body. The range of oscillation is adjustable through a wide angle even while the fan is running. Any interference with the oscillation operates a safety release to protect the mechanism. The desk type oscillators are also adjustable for bracket or wall mounting. A special wall type oscillator is also made which is mounted in a trunnion to give a fixed inclination of 30 degrees; this fan is particularly used in theaters, assembly halls and the like.

The company also makes an eight-inch fan in which light weight is obtained by the use of die castings. The motor casing and one end cover are cast in one piece. These fans are adjustable for desk or bracket use. An eight-inch telephone-booth fan of similar die-cast frame construction is likewise listed in the Diehl line, which also includes several types and sizes of ceiling and exhaust fans.



Diehl Pressed-Metal Desk and Bracket Fan.

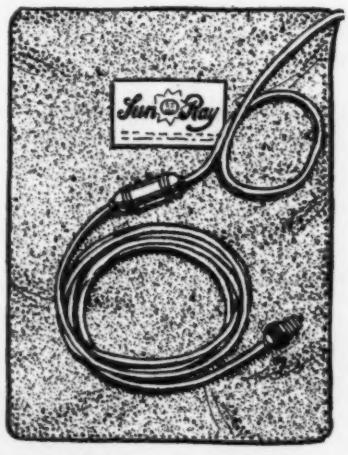
Pressed-Metal Fan Arranged for Wall Mounting.



Six-Blade Pressed-Metal Fan.

Sun-Ray Electric Heating Pad.

The electric heating pad has so many advantages over the old hot-water bottle in relieving pains of nearly all kinds that its use should be available in every home and hospital. One feature that has prevented the more general use of electric pads has been the comparatively high first cost thereof heretofore.



Flexible Heating Pad.

A new type of electric heating pad that meets this situation and which has other strong claims for consideration has recently been placed on the market. In external appearance it is not unlike other electric pads, being 12 by 16 inches in size and covered with soft, thick eiderdown. The heating element, however, consists of exceptionally flexible resistance wires that are well distributed throughout the body fabric. Therefore the prominent hard ridges noticeable in many pads due to thick, hard wires are absent in the new pad, which is unusually flexible and comfortable. An automatic thermostat shuts off the current when a predetermined temperature, maximum for comfort, is reached; when the temperature falls below this a few degrees, the current is again automatically turned on. The heating element is covered with a fireproof fabric, so there is no danger from possible rupture of the wires. The heating element, as well as the other parts of the pad, is guaranteed for two years from date of purchase by the user.

Two types of these pads are made. One has a single-heat element and the other a three-heat element. The latter is obtained by means of a double winding, of which one part takes 18 watts and the other 36 watts, both together furnish the third heat, which takes 54 watts. A double push-button feed-through switch permits convenient control of heat. A 10-foot connecting cord and separable attachment plug is furnished with each pad.

This pad is known as the Sun-Ray electric heating pad and is manufactured by the P. & B. Manufacturing Company, Milwaukee, Wis.

Electric Bacteriological Incubator.

An electric bacteriological incubator has recently been placed on the market which, it is claimed by the manufacturer, is a vast improvement on the gas-heated machine so generally used now. The uniform temperature regulation obtained in the electric machine is its strong feature. When once adjusted to the desired temperature, it will operate for days at a time with absolutely no attention. The machine is heated through electrical resistance coils located in the top.

The temperature is controlled by the all-on and all-off principle. A wafer thermostat inside the machine expands with the rise in temperature and pushes up on a piston stem, which raises and lowers a balanced lever arm that carries two electrical contact points. These two contact points dip in mercury cups connected in series with one side of the electrical feed circuit. When the temperature inside the incubator reaches the desired point, the contact points are lifted out of the mercury, thus shutting off the current. When the temperature falls just a small fraction of a degree the contact points are lowered back into the mercury and the current is turned

on, thus bringing the machine back to proper temperature. A variation of less than one-tenth of a degree will cut the current on or off. The temperature is set at any desired point by means of an adjusting screw. A miniature lamp inside floods the incubator with light when the button is pressed.

The box is doubled-walled throughout with a one-half-inch air space between.

Electric Bacteriological Incubator.

The outer box is finished in mahogany. It has double doors, the inner one with a glass panel so that the contents of the machine may be readily inspected without opening the door. The incubator connects to any lamp socket and can be used in a physician's office, as the temperature inside the machine is unaffected by air drafts or variations in room temperature.

The maximum energy taken by the machines is approximately 50 watts and the average consumption per hour about 25 watt-hours. The inside dimensions of the standard machine are 8 inches wide, 16 inches long, and 10 inches high. Special machines can be built to order.

The simplicity, safety, cleanliness and convenience of these electric bacteriological incubators should commend them to physicians, pathologists, and bacteriologists, both for office and laboratory use. They are manufactured by the Electric Specialty Company, 154 Main Street, Salt Lake City, Utah.

Robbins & Myers Exhibit at Panama-California Exposition in San Diego.

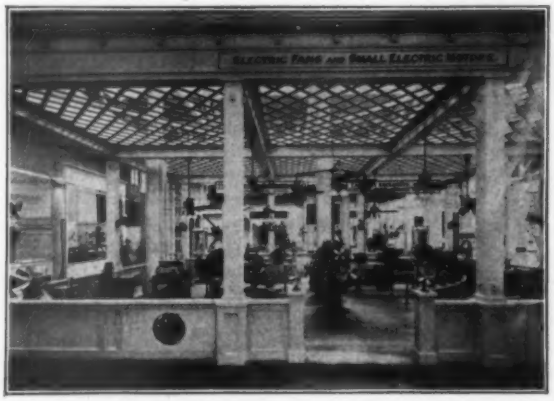
The illustrations herewith show two views of the exhibit installed by the Robbins & Myers Company, of Springfield, O., in the Home Economy Building at the San Diego Exposition.

The central feature of the display is a revolving stand upon which a solid bank of desk fans are mounted in the form of a cone. In addition to the motion of the display as a whole all of the fans are in operation. A central column with arms branching from the top supports three ceiling fans, which are also in operation. Other fans of all types are mounted at various points about the exhibit.

Immediately surrounding the revolving fan display are circular display benches upon which the complete line of Robbins & Myers small motors is exhibited, from the one-fortieth-horsepower size up to 15 horsepower. Direct-current motors are displayed on one-half of the circular bench and alternating-current motors are shown on the other half.

The remainder of the space is given to small machines of all kinds which are equipped with Robbins & Myers motors. The following list of the machines which make up this feature of the display will give some idea of the variety which has been obtained here:

Adding machines, addressing machines, portable electrical tools, house pumps, air compressors, vacuum cleaners, ventilating fans, corn poppers, candy furnace, organ blowers, washing machines, cuspidor polisher, carbonator, engraver's machine, knife grinder, bench lathe, humidifier and churn.

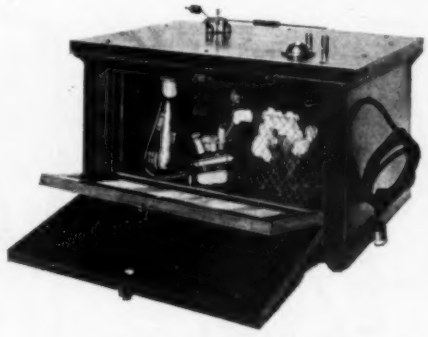


General View of Robbins & Myers Exhibit at San Diego.

Corner of the Exhibit Booth.

Kimble Adjustable-Speed Single-Phase Motor

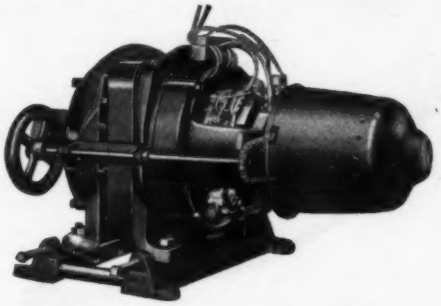
Alternating-current motors have hitherto not been used for driving machinery in which the speed must be varied at will through a wide range and kept substantially constant at each speed adjustment, regardless of load. The reason for this was that no type of alternating-current motor possessed this characteristic, which is met so successfully by the direct-current shunt motor with field control for speed. Therefore direct-current drive was used in many cases where alternating-current operation would have been preferred, but for its lack of adjustable-speed setting.



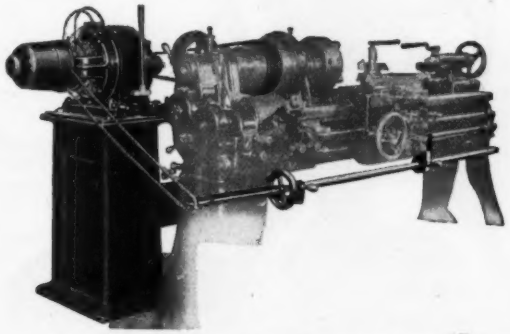
Bacteriological Incubator Open.

As the result of prolonged experimental and development work by the engineers of the Kimble Electric Company, of Chicago, there has been placed

on the market an ingenious adjustable-speed single-phase motor that meets these exacting requirements of machine-tool drive. It has a speed range ordinarily from 1,800 through all intermediate values to 600 revolutions per minute and can even be built in the smaller motors to have a speed range of 6 to 1, say from 3,600 to 600 revolutions per minute. Whatever speed the motor is set to will be maintained within a few per cent when the load is changed as violently as from full load to no load.



Kimble Adjustable-Speed Single-Phase Motor.



Kimble Motor Mounted on Pedestal for Driving Lathe.

As typical of this performance may be cited repeated tests of a 1.5-horsepower motor in which the load was changed in this manner at various speeds and with a speed rise from full load to no load, ranging from 2 per cent at the highest speed (1,800) to 5 per cent at the lowest speed (600). Thus the fluctuations in speed due to load are less than in a squirrel-cage induction motor of the same size.

This new motor is a series compensated motor with special speed governor, which is entirely inclosed within the motor frame. There are no external resistances, relays or switches. The speed-adjustment device includes a compact fly-ball governor attached to the end of the rotor shaft. This acts like a throttling governor of a steam engine in that by hand adjustment the speed can be set to any desired point within the speed range, and when once set the governor automatically maintains this speed practically constant. Included in the governing device is a contact-maker that regulates, through increase or decrease, the time in which energy is supplied to the motor, thus closely regulating the speed to the predetermined setting. By means of a handwheel mounted on the motor or connected to its governor by chain and sprockets, the machine-tool operator is enabled to secure any speed adjustment to suit exactly the requirements of his work.

Two standard mountings of the Kimble adjustable-speed motor have been developed. In the first the motor is placed on slide rails secured to a pedestal that is fastened to the floor. The motor is belted to the machine with adjustable belt tension. This mounting relieves the machine of any motor vibration. In the second mounting the motor is secured to the back of a cantilever whose bottom end is hinged to the floor; the entire mounting can be swung toward or away from the machine to adjust belt tension. The use of cone pulleys and elaborate gear sets is dispensed with, since the motor speed itself is widely adjustable.

In the accompanying illustrations are shown several views of the new Kimble motors and the two methods of mounting just referred to.

These Kimble motors are made in sizes varying from one-sixth horsepower to 2.5 horsepower, inclusive. The standard speed range is from 600 to 1,800 revolutions per minute; this speed range can be increased where special requirements must be met. Standard voltages are 110 and 220. The motors operate on any frequency from 25 to 60 cycles. Their design and construction is covered by letters patent issued on February 9, 1915, to Austin Kimble and John D. Nies, and assigned to the Kimble Electric Company, 634 North Western Avenue, Chicago, Ill.

Another Mounting of Motor.

Manufacturer Establishes Salesmanship Course for Retailers' Sales Force.

During the past year or two there has been a steady increase in the sales helps of various kinds offered by manufacturers and jobbers to retail dealers. It has remained for the Hotpoint Electric Heating Company, however, to extend this co-operative work into a new channel by organizing a course in salesmanship for the special benefit of the salespeople, both men and women, employed by retail dealers of its heating appliances. This course has been formed under the name of Hotpoint School of Salesmanship and is also open to the retailers themselves.

The need for such a course has become apparent from the lack of knowledge of the fundamental principles of electricity, of the characteristics and advantages of electric heating appliances and even of the essentials of salesmanship that has been found among the retailers and their employees, all of which has limited their capabilities of giving the best service and therefore restricted their sales. The The course to be given by the Hotpoint school will be by correspondence from the headquarters of the Hotpoint Company at Ontario, Cal.

Lessons in the course will be 15 in number, divided into three sections of five lessons each. Section 1 deals with electricity, its nature and properties, its units and measurement, cost of operating electrical devices, troubles and their prevention, uses and limitations of electricity in the home. Section 2 is devoted to electrically heated appliances and takes up first the con-

version of electricity into heat, then proper connecting of heating devices to circuits, detailed consideration of various devices, irons, heaters, ovens, stoves, etc., and finally the care, maintenance and guarantee of appliances.

Rotarex for Testing Paving Materials.

Fig. 2.—Stow Suspended-Type Tool With Flexible Shaft.

Section 3 covers the salient features of salesmanship, taking up points to be observed in getting ready for the customer, in actually meeting the customer, efforts to keep the customer, methods the salesman may follow to improve himself and how he may help his employer.

From the large number of salespeople already enrolled in the Hotpoint School of Salesmanship, which was organized less than two months ago, it is evident that it is meeting a decided need and that the retail sales force realizes there is much room for improvement in intelligent retail electrical merchandising. That this will prove of benefit to all parties concerned, including the ultimate purchaser, is a foregone conclusion.

The Dulin Rotarex.

The Dulin Rotarex is a centrifugal machine designed for extracting bituminous aggregates, and is especially adapted for analyzing paving and road compounds, such as bitulithic, macadam, and ordinary surface mixtures. A simple speed-changing switch on the base accommodates the machine to various mixtures.

This little machine does in a few minutes the work that required several hours with older methods. Tests have proven that an inexperienced operator can do the work of three and one-half hours in six minutes. Samples can be taken from mixers or wagons, and their constitution determined before dumping and without delaying the work. Hence exact information can be obtained at every step, proportions checked, weighings verified, etc., without loss of time or risking faulty work. The states of New York, Pennsylvania, Maryland, West Virginia and New Jersey, and many of the largest cities rely entirely on this little machine in testing paving and road materials.

The Rotarex is small, and can be easily carried from place to place. It is driven by a Westinghouse Electric high-speed motor, which will operate on any lighting circuit. It is manufactured by the Braun Corporation, Los Angeles, Cal.

Fig. 1.—Stow Electric General Utility Tool.

Stow Electric General Utility Tools With Flexible Shafts.

In meeting special orders for motor-driven tools equipped with flexible shafts for use in die sinking, grinding, buffing, polishing, etc., the Stow Manufacturing Company, Binghamton, N. Y., has developed a number of electric tools of great utility, two of which are illusrated herewith.

Fig. 1 shows a tool which is especially applicable where a wide range of flexibility and speed is desired. It consists of an adjustable standard upon which is pivoted the main rod having at one end a Stow flexible shaft and at the other end a motor, the latter serving both as power unit and counterweight. Power is transmitted to the flexible shaft through an intermediate countershaft, using a round belt. A sliding rod is provided to vary the distance between pulley centers when a new arrangement of pulleys is made. The standard can be raised or lowered, the whole outfit can be easily moved, and the flexible shaft is four feet or more in length, making it possible to reach any part of ordinary construction work, such as carriage building, automobile work, and wood-working in general. By means of the countershaft and pulleys, three of the latter being interchangeable, a range of speed between 400 and 7,000 revolutions per minute can be obtained, thus making the machine suitable for drilling in wood or steel, grinding, buffing die sinking, screw driving and similar work.

The tool can also be dismounted from the standard, and suspended from the ceiling, similar to the Stow suspended-

type direct-connected tool shown in Fig. 2. When one speed alone is desired for grinding or buffing, or light drilling, the suspended type without countershaft is recommended. This tool is very serviceable in assembling work, since it has a large radius of action and can be mounted over the work so as to be out of the way and yet quickly accessible.

Both these tools are made for 110 or 220 volts direct current and for similar voltages on 60-cycle single-phase current.

Portable Motor-Driven Winch.

The construction of the New York Subway necessitated the building of the portable motor-driven winch shown in the illustration. It has, however, since demonstrated its usefulness in many other fields.

When used for lifting material out of the subway, a trestle or light framework carrying a sheave is placed directly over the opening. The hoisting rope is passed over the sheave, given two or three turns around the friction drum, the motor started and the slack paid off as the material is hoisted. When used to assist teams in hauling loads up heavy grades, one end of the rope is fastened to the wagon tongue and the other end given several turns around the friction drum. Current is obtained from the 550-volt trolley circuit.

The winch is manufactured in two sizes by the Dobbie Foundry & Machine Company, Niagara Falls, N. Y. The small outfit operates at a rope speed of 152, and the large one at 178 feet per minute. Westinghouse compound-wound motors at 5 and 7.5 horsepower, respectively, are used to drive these outfits, which are said to be very light and compact and easily portable.

Clip for Holding Non-Metallic Conduit in Outlet and Switch Boxes.

To secure non-metallic flexible conduit, such at Circular Loom, Duraduct, etc., in the knockouts of outlet and switch boxes requires a special fastening means. A new clip for this purpose fears the trade name "Bull Dog" loom clip, to indicate the tenacity with which it grips the duct and holds it in place. As shown in the cut herewith, this clip is made of a single piece of galvanized steel. It is placed over the end of the duct and straightened out with the pliers; this causes it to grip the loom securely. The two projecting lugs are then pushed outward through the knockout and bent over on the outside of the box, as shown; this locks the loom or duct in place and prevents slipping either way. The clip is flat against the inside of the box and does not interfere with the switch, receptacle or other fitting in the box.

"Bull Dog" Loom Clip.

These clips are made in two sizes for five-eighths and seven-eighths-inch knockouts. Their use is a means of decreasing cost of installation and improving its quality. Bull Dog clips are made by the Christo Manufacturing Company, Richmond, Va.

The Tata $2,000,000 hydroelectric system supplying power to Bombay, India, began operation on February 8.

Robbins & Myers Company on Overtime Schedule.

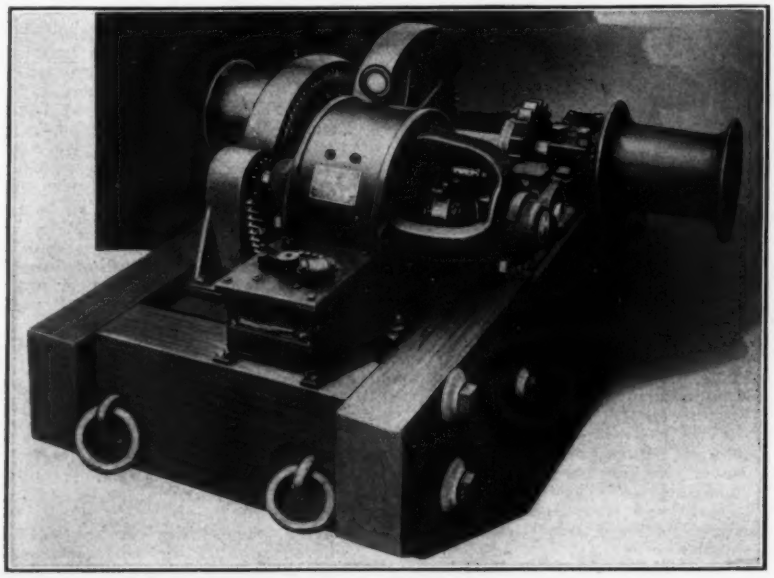
As an indication of the way in which business is picking up in general and in particular as it affects the electrical industry, the fact that the Robbins & Myers Company, Springfield, O., has had such an increase in business since the first of the year that several departments are now working overtime ic of special interest. The Robbins & Myers Company is the manufacturer of a celebrated line of electric motors, generators and the "Standard" fan motor. Early this year a large new concrete structure, greatly enlarging the plant, was occupied.

New Drilling Stand for Portable Electric Drill.

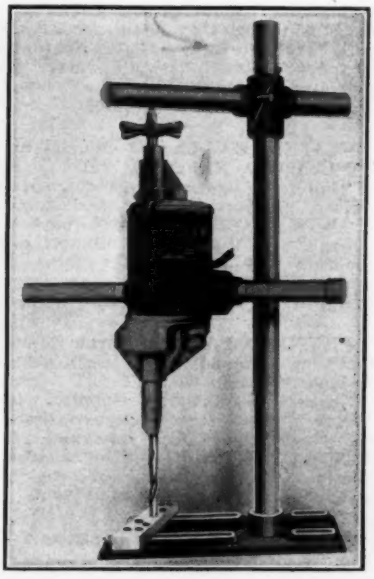
The illustration herewith shows a new drilling stand or "old man," which is now being placed on the market by the Standard Electric Tool Company, Cincinnati, O., for use in connection with its high-power portable electric screw-feed drills.

This is made in two sizes for the one-half, five-eighths and three-quarter-inch drills and also for the seven-eights, one, and one and one-quarter-inch drills. These drills are made in the universal type and operate on direct and alternating current, have ball bearings throughout and have motors impregnated with Bakelite. The weight of the small stand is 50 pounds and the large stand 75 pounds.

This attachment is particularly adapted for structural-iron workers or any place where much heavy drilling is to be done with portable electric tools.



Portable Motor-Driven Winch for Construction Work.



Stand for Portable Electric Drill.

Latest Approved Fittings

The electrical fittings illustrated and described in this department have been approved by the Underwriters' Laboratories, Incorporated, following examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association.

CABINETS. — Detroit Fuse and Manufacturing Company, 1400 Rivard Street, Detroit, Mich.

Cabinets shown by tests and examinations conducted by Underwriters' Laboratories to be in accordance with requirements of the National Board of Fire Underwriters have labels attached.

Approved January 21, 1915.

CABINETS. — Detroit Fuse and Manufacturing Company, Windsor, Ontario, Can.

Cabinets shown by tests and examinations conducted by Underwriters' Laboratories to be in accordance with requirements of the National Board of Fire Underwriters have labels attached.

Approved January 22, 1915.

CABINETS. — Large-Dail Manuturing Company, 114 North Thirteenth Street, Philadelphia, Pa.

Cabinets shown by tests and examinations conducted by Underwriters' Laboratories to be in accordance with requirements of the National Board of Fire Underwriters have labels attached.

Approved January 25, 1915.

FASTENER. — Christo Manufacturing Company, Richmond, Va.

"Bull-dog" fastener consisting of a square, galvanized, sheet-steel washer having internal edges formed to engage with surface of tubing. For securing 0.25-inch flexible tubing in switch and outlet boxes.

Approved January 11, 1915.

PIXTURE PARTS.—Harter Manufacturing Company, 1132 West Austin Avenue, Chicago, Ill.

"Harter" adjustable support for "Harter" lamp receptacle, consisting of a galvanized steel yoke and two clamping bands inclosed in a brass shell.

Approved December 30, 1914.

HEATERS, Electric. — The American Laundry Machinery Company, 1824 North Spaulding Avenue, Chicago, Ill.

Pressing irons, 5, 6 and 7.5 pounds, not over 250 volts.

Each pressing iron is part of a device consisting of pressing-iron support, a vertical piece of rigid steel conduit fitted with a clamp for bolting to a bench or wall, swiveling arm for heater cord, a flush switch, and a pilot light.

Records show that electric pressing irons when left with the current turned on are frequent causes of fire. In the irons listed above no adequate means have been provided for eliminating this recognized hazard. In other electrical and mechanical details these irons and accompanying stands are judged to be suitably constructed.

Approved January 30, 1915.

LAMP GUARDS.—Appleton Electric Company, 212 North Jefferson Street, Chicago, Ill.

"Appleton" vaporproof lamp guards. These devices consist of "Unilet" conduit boxes, each fitted with a glass globe and metal guard.

Type G, 550 watts, 250 volts.

Approved January 19, 1915.

PICTURE MACHINES AND APPLIANCES. — Motion Picture-Scope Company, Peoples Gas Building, Chicago, Ill.

"Safety-Scope" portable, hand-operated, motion-picture machine, made in two types; one having a tripod base and the other having mechanism mounted in a transite asbestos board case.

The electrical parts of this device comprise a 100-watt gas-filled, incandescent lamp of special form, and a portable cord for attachment to supply circuit.

Approved January 29, 1915.

RECEPTACLES, For Attachment Plugs.—Albert and J. M. Anderson Manufacturing Company, 289 A Street, Boston, Mass.

Type A. B. C. plugs and receptacles, 50 and 100 amperes, 125 volts. For use in charging storage batteries, and consisting of cylindrical spring contacts in molded-composition insulating bases inclosed in cast-aluminum shields.

Approved January 29, 1915.

RECEPTACLES, For Attachment Plugs. — Bryant Electric Company, Bridgeport, Conn.

"Bryant" or "Perkins."

Flush type.

"Junior," 6 amperes, 250 volts, 12 amperes, 125 volts, catalog Nos. 411-Sp, 507, with plate 507-Sp.

Disappearing Door Type, 10 amperes, 250 volts; base and plate, catalog No. 489; plug and bracket, catalog No. 490.

Junior to Edison adapter, 660 watts, 250 volts, catalog No. 472.

Edison to Junior adapter, 660 watts, 250 volts, catalog No. 468.

Approved January 12, 1915.

RECEPTACLES, For Attachment Plugs.—The Trumbull Electric Manufacturing Company, Plainville, Conn.

Flush receptacles, 660 watts, 250 volts, catalog No. 1011.

Approved February 4, 1915.

RECEPTACLES, Standard. — Harter Manufacturing Company, 1132 West Austin Avenue, Chicago, Ill.

"Harter." Keyless, 660 watts, 250 volts, catalog Nos. 61, 62.

Approved December 30, 1914.

ROSETTES, Fuseless. — J. C. Phelps, 392 Main Street, Springfield, Mass.

"J. C. P." porcelain rosette with supports for attaching to outlet boxes with plain ring covers plastered into wall or ceiling. Catalog No. 15.

Approved February 9, 1915.

ROSETTES, Fuseless.—The Trumbull Electric Manufacturing Company, Plainville, Conn.

"Circle T," 3 amperes, 250 volts. Cleat, catalog No. 748.

Approved January 30, 1915.

SOCKETS, Standard. — General Electric Company, Schenectady, N. Y.

"B. E." Keyless, 1,500 watts, 250 volts, catalog Nos. GE514, GE516.

Also the above types with shade-holders attached.

Approved December 31, 1914.

SWITCHES, Combination Cutout.—Metropolitan Engineering Company, 1238 Atlantic Avenue, Brooklyn, N. Y.

"M. E. Co." combination sealable service switches and cutouts having a fuse in each line, and special handle whereby all may be withdrawn simultaneously when device is used as a switch. Some of these devices are provided with spring contacts for meter-testing plugs. 250 volts, 0-30, 31-60 and 61-100 amperes. Catalog No. 145.

Note.—These devices are not considered suitable for use in connection with secondaries not properly grounded, since they are not so designed that they can be promptly opened by a single operation.

Approved January 29, 1915.

SWITCHES, Rotary Flush.—The Bryant Electric Company, Bridgeport, Conn.

"Bryant" or "Perkins." Combination switch and pilot lamp.

These devices each consist of a "Perkins" flush switch and pilot lamp mounted on a porcelain base and provided with a single face plate.

10 amperes, 125 volts, catalog No. 469.

Approved January 12, 1915.

Current Electrical News

NEW CONSTRUCTION.

On the Following Pages Will be Found a Very Interesting Recapitulation of Information Regarding the Requirements of Electric Light and Power, Electric Railway, Telephone and Telegraph and Industrial Corporations of Every Description. Notwithstanding So-Called Hard Times, a Great Many Public Utilities and Industrial Organizations are Contemplating a Vast Amount of Construction, Which Will Mean an Active Demand for Materials Entering Into Every Phase of Electrical Equipment and Operation.

NORTH ATLANTIC STATES.

AUGUSTA, ME.—The Central Maine Power Company, W. S. Wyman, treasurer, will expend not to exceed $90,000, for new construction work. The amount may be limited to considerably less, however.

BELFAST, ME.—The Penobscot Bay Electric Company is about to develop water powers at Sherman's lower mill in East Belfast, where a dam will be erected and the water carried to the company's power station at tide water. A new generating unit of about 600 horsepower will be installed in a new brick and cement station to be built on the site of the present wooden structure. Work will be begun early in the spring. W.

PORTLAND, ME.—A coal pocket, 90 by 40 feet and 49 feet high, to be erected by the John H. Proctor Company, of Boston, for the Cash Coal Company, of this city, will be equipped with coal-hoisting apparatus of modern type and four automatic railways. Work will be begun about April 1. W.

MILTON, N. H.—John B. Giguerre has petitioned the Public Service Commission for authority to construct and operate an electric light and power plant in this town. W.

BOSTON, MASS.—Electric stoves will be the exclusive cooking equipment in the kitchen of the fine new house to be built the coming spring for Mayor Curley.

CONCORD, MASS.—The Concord municipal light plant, A. W. Lee, manager, may construct a mile or two of primary lines, and will replace from fifty to one hundred old-style street fixtures.

GLOUCESTER, MASS.—The Gloucester Electric Company, Wm. H. Jordan, president, is replacing an old belted 400-horsepower engine with one 750-horsepower direct-connected to an alternator in process of erection.

PITTSFIELD, MASS.—The Pittsfield Electric Company, W. A. Whittlesey, manager, will expend $8,000 on underground construction, and $8,000 in general overhead extensions.

SALEM, MASS.—Council has voted to place investigation of the proposal that the city manufacture its own electric current in the hands of the service director, who has been instructed to ascertain the approximate cost of purchasing and installing at the pumping station a low-pressure steam-driven turbo-generator of sufficient capacity to furnish current for the municipal electric distributing system.

SPRINGFIELD, MASS.—The United Electric Light Company, W. L. Mulligan, manager, will install approximately two miles of underground conduit, contract having been let to Fred T. Ley & Company, Springfield.

BRISTOL FERRY, R. I.—Citizens are asking the Public Utilities Commission to see to it that electric lighting be extended into this town. The Bay State Street Railway Company now supplies electricity for power, light and heat to Newport, Middletown and Portsmouth, and its franchise provides that service shall be extended wherever the return will be five per cent net. This would mean a net income of about $800 a year from Bristol Ferry, and the company wishes to have a guarantee of this amount yearly. W.

WOONSOCKET, R. I.—The Blackstone Valley Gas and Electric Company, A. F. Townsend manager, is completing the installation of approximately 15 miles of 13,000-volt transmission lines.

BRANFORD, CONN.—The Housatonic Power Company, A. S. Jourdan, superintendent, is completing rehabilitation of its entire overhead equipment. The work has been in progress about one and a half years and will be finished about July 1. The company contemplates some small extensions.

SOUTH NORWALK, CONN. — The United Electric Light and Water Company, B. H. Gardner, manager, will probably built a few short extensions.

ALBANY, N. Y.—The electrical department of the Municipal Gas Company, A. Anderson, manager, will build a 30,000-kilowatt power station.

POUGHKEEPSIE, N. Y.—The Central Hudson Gas and Electric Company, H. M. Beugler, operating manager, has under way the installation of a 7,500-kilowatt steam turbine and auxiliary apparatus. Apparatus contracted for and construction well under way.

WEEDSPORT, N. Y.—A decision by the Pubilc Service Commission, holding that the election held in the village of Weedsport last November, at which the municipal lighting plant proposition was carried, to be legal, has been received. The report favors the village in all respects, according to a statement made recently by Frank M. Parsons, president of the village.

BAYONNE, N. J.—A movement has been inaugurated by the John P. Smith Assocation and others for the installation of a "white-way" street-lighting system along Broadway. A.

JERSEY CITY, N. J.—A committee from the Bergen Club is negotiating for the installation of a new street-lighting system, forming a "white way," on Bergen Avenue, between Fairmount and Sip Avenues. A.

ROCKAWAY, N. J.—The International High Speed Steel Company, now erecting a new plant at this place, has entered into contract with the Eastern Pennsylvania Power Company to furnish electric energy for operation. A.

ALLENTOWN, PA.—Lehigh Valley Light and Power Company, A. H. S. Cantlin, manager, with its parent and allied companies, expend normally from $50,000 to $100,000 per annum for new construction and rehabilitation of existing lines. The signs for the present year are that this will at least be equalled. These expenditures will be principally for transformers, meters, wire, etc., for customers within or close to the territory already served.

ALTOONA, PA.—The Penn Central Light and Power Company, F. E. McEntire, superintendent power department, with main offices at Altoona and lines extending along the main line of the Pennsylvania Railroad from Summerhill on the west, to Lewistown on the east, plans to invest about $100,000 for the extension of lines to serve power consumers in the territory already occupied. An appropriation has also been made for the extension of lines into new territory as fast as business warrants. These proposed additions will make necessary an increase in capacity of the generating plant recently installed at Williamsburg.

BRADFORD, PA.—The Bradford Electric Light and Power Company, J. H. Rose, secretary, is installing a 600-horsepower Westinghouse gas engine, direct-connected to a 400-kilowatt, three-phase, 60-cycle generator; also a 300-kilovolt-ampere synchronous condenser.

LEHIGHTON, PA.—The Lehighton Electric Light and Power Company will replace its water-tube system, and completely overhaul its main bank of 350,-horsepower Stirling boilers, including the rebuilding of arches and brick work and remodeling stack base. The company will carry through general summer repairs on lines now existing, with some changes of series incandescent to arc circuit and some changes in transformer location on the domestic service lines.

RIDGWAY, PA. — The Ridgway Electric Light Company, Charles R. Law, cashier, intends to change its entire system, the plant to be run by steam instead of gas as at present. A high-voltage line is to be built between Ridgway, Johnsonburg and Kane, and an electrical store will be opened.

TITUSVILLE, PA.—The city manager's office, Herbert A. Holstein, manager, is about to equip the street lighting plant with new alternating-current generating equipment and incandescent lamps in place of the present direct-current arc system. All inquiries should be addressed to Mr. Holstein. Fred C. Johnson is the city electrician and has charge of the lighting system, John Smith is chief engineer in charge of the power plant.

SOUTH ATLANTIC STATES.

WHEELING, W. VA.—The Wheeling Electric Company, J. B. Gardner, vice-president and general manager, will extend its high-tension line from Glencoe, O., to Barnesville, O., a distance of 20 miles; will also complete a high-tension line from Rayland, O., to Steubenville, O., upon which some work has been done; will build a high-tension line from Wheeling to Moundsville, a distance of 10 miles; will make numerous short extensions.

GIBSON CITY, N. C.—The city will install an electric light plant; two hundred 60-watt and twenty 112-watt lamps, equipment needed. Cost of installing lamps, $600. Address J. E. Doster, mayor.

WILSON, N. C.—The Wilson water and light department, R. J. Granthum, superintendent, is just completing a new 1,500-horsepower plant.

UNION, S. C.—The Municipal Electric Light and Water Works, R. A. Easterling, superintendent, will install four miles of 6,600-volt, three-phase transmission line to new motor-driven pumping station.

COLUMBUS, GA.—The Columbus Power Company, John S. Bleecker, manager, will make usual short line extensions, the total amount to be expended not over $40,000 as estimated now; the Columbus Railroad Company contemplates some slight rehabilitation of its lighting and power distribution system, and some slight track reconstruction, both together will run to about $25,000; the usual short line extensions for new lighting and power customers will probably not exceed $15,000.

NORTH CENTRAL STATES.

CINCINNATI, O.—Bids for the construction of the new Cincinnati courthouse, which will cost over $2,500,000, are in the hands of Rankin, Kellogg & Crane, architects, of Philadelphia, for tabulation and recommendation. The Union Gas and Electric Company, of this city, has suggested that it can furnish current for the building, for light and power, more cheaply than it can be furnishel by a separate plant, investment and operation considered, and asks to be allowed to submit a proposition before the contract is let providing for an electric plant. L.

CINCINNATI, O.—A considerable amount of equipment of various sorts will be required in connection with the electrical work on the 10-story Duttenhoefer building, which has been awarded to the Beattie Electrical Company, of this city. S. S. and G. H. Godley are the architects. L.

CINCINNATI, O.—A. Wottitz, who will handle the electrical work on the $30,000 St. Andrew's Protestant church, will require considerable equipment, including wiring and fixtures. Samuel Hannaford & Sons, architects. L.

COSHOCTON, O.—The Ohio Service Company, C. H. Howell, manager, expects to complete this year its 33,000-volt transmission system which will connect the cities and villages of Strasburg, Canal Dover, New Philadelphia, Midvale, Dennison, Uhrichsville, Newcomerstown, West Lafayette, Coshocton, Cambridge and Byesville, O. In addition to this it expects to begin shortly the construction of a 13,000-volt transmission line to Tippecanoe, O., a distance of nine miles.

FINDLAY, O.—The Toledo, Bowling Green & Southern Traction Company, Charles F. Smith, general manager, intends rehabilitating its electric lines, and instead of the 219 arc lamps now in use for street lighting will install 432 lamps of various candlepower, giving a better distribution of light.

FREMONT, O.—The Ohio Light and Power Company, B. J. Shockley, superintendent, contemplates rebuilding some of its local primary lines for added capacities and the building from the main generating plant at Tiffin, of a high-tension line to Fremont.

FT. LORAINE, O.—A small power plant will be constructed by the Ft. Loraine Light and Power Company, recently incorporated with a capital stock of $10,000 for the purpose of building such a plant. L.

MIDDLETOWN, O.—The Middletown Gas and Electric Company, L. C. Anderson, general manager, expects to build between 12 and 15 miles of new lines.

MIDDLETOWN, O.—The City Commission has under discussion the question of improving the lighting system of the city. This will include ornamental and boulevard lights, and the clerk of the commission has been authorized and instructed to advertise for bids on the contract.

PAINESVILLE, O.—The present electric light plant is greatly overtaxed. Improvements are necessary. Address city clerk.

RIPLEY, O.—The $12,000 of municipal electric light bonds, bearing five per cent interest, have been sold to the Citizens National Bank, of Ripley, at par and accrued interest.

SANDUSKY, O.—The Sandusky Gas and Electric Company, E. A. Bechstein, manager, is installing a complete new street-lighting system, covering all parts of the city, and including a "white way" system in the business district. The "white way" will consist of 190 two-light ornamental standards, equipped with 250-candlepower series tungsten nitrogen-filled lamps. All wires in this district will be underground. Work is now in progress and the specifications require the "white way" to be completed and in operation by April 1. All other parts of the city will be lighted by 920 series tungsten, nitrogen-filled lamps, varying from 60 candlepower to 250 candlepower. This will provide a lamp for every street corner in the city and from one to three additional lamps in each block. This portion of the city is required to be completed by August 1. As far as practicable the present distribution system will be utilized, but there will be considerable new construction. The 1,300 lamps contracted for will supplant 225 arcs now in use. A 10-year contract for the new system was recently closed between the company and the city.

SPRINGFIELD, O.—The Springfield Light, Heat and Power Company, W. Parsons, treasurer and general manager, will spend quite a considerable amount on general construction and rehabilitation. The present estimate for underground construction amounts to approximately $60,000, and undoubtedly as much will be spent on overhead work. Definite decision has not been made relative to betterments in the power house which will undoubtedly take place.

WARREN, O.—The Trumbull Public Service Company, E. L. Franklin, general manager, is planning to install an additional 3,500-kilowatt turbine some time during the next six months.

CRAWFORDSVILLE, IND. — The Crawfordsville Electric Light and Power Company, F. H. Miller superintendent, expects to install shortly a small motor-driven air compressor, twin strainers on the condenser intake and non-return valves on the boilers. An electric truck is one of the early probabilities.

EVANSVILLE, IND.—The Evansville Public Service Company is constructing an addition to its Division Street station in which it will install a 6,250-kilovolt-ampere turbine and condenser; two 500-horsepower B. & W. boilers, and an auxiliary equipment including five 12-inch wells, which will be put down to a depth of 100 feet.

GARY, IND.—The Gary Heat, Light and Water Company, Leonard Fitzgerald, vice-president, is extending its electric lines, both arc and incandescent, from Gary to West Gary and Clark Station, suburbs, almost three miles from Gary; charging over single-tube mercury rectifiers and making two-tube sets of them.

GOSHEN, IND.—The Hawks Electric Company, Owen C. Cover, secretary and treasurer, proposes building a 10-mile extension to Middlebury, Ind., single-phase, 6,600 volts; local distributions, 2,200 and 110-220; 40 street lamps, 6.6 ampere, series; 15 miles of suburban and rural lines, 6,600 or 2,200 volts to 110-220, all single phase.

HUNTINGTON, IND.—The municipal electric light plant, J. W. Hier manager, is installting a 2,000-kilowatt turbine unit, three mercury rectifiers of 75-light capacity each, 200 new metallic flaming arc lamps, two new water-tube boilers, one new 2,500,000-gallon water works pump, two condensers, all new piping system, new heaters, new switchboard, and will rebuild all of its pole lines.

MARION, IND.—The Marion Light and Heating Company, O. M. Drischel superintendent, in the event of business conditions improving has in prospect the installation of 14 to 15 miles of transmission lines from Fairmount into Fowlertown, Matthews and Gaston, to be built as a rural system, and to supply

farms along the line with current for both light and power. A 500-horsepower turbine unit is also a later possibility.

NOBLESVILLE, IND.—The Noblesville Heat, Light and Power Company, J. T. Kester manager, has bought material to the extent of $12,000 for a new street-lighting system, and $5,000 for other new construction work.

CHICAGO, ILL. — The Commonwealth Edison Company is installing a 30,000-kilowatt General Electric turbine in its Northwest Station; the machine will probably be in Chicago during the next 60 days, and installation will proceed so that it will be ready for the fall and winter load.

CANTON, ILL.—The Canton Gas and Electric Company, E. H. Negley secretary and manager, is engaged in erecting one 40-foot, one 60-foot and two 90-foot steel towers to carry transmission lines across the Illinois River, over which it is expecting to furnish power to the Spring Lake Drainage District's pumping station, the plant of which is being converted to motor drive; this motor equipment will include two 300-horsepower and one 100-horsepower Westinghouse slow-speed motors, driving two 48-inch and one 24-inch centrifugal pumps which will drain the water from 12,000 acres of reclaimed bottom land. The Banner Special Drainage District is already formed and expects to complete its pumping station this year. This district will drain 7,500 acres and will have a total connected demand of 300 horsepower, which the company will build one mile of transmission line to serve from the line now constructed to the Spring Lake District.

PEORIA, ILL.—The Illinois Traction System will undertake the following central station construction and rehabilitation during the current year: DES MOINES—Installation of one 4,000-kilowatt Allis-Chalmers condensing turbine unit with auxiliary apparatus; installation of two 500-horsepower B. & W. boilers; completion of new boiler-room building. RIVERTON—Complete installation of one 7,500-kilowatt Allis-Chalmers turbine unit; two 450-horsepower B. & W. boilers. LA SALLE—Complete installation of one 2,000-kilowatt General Electric turbine condensing unit with auxiliary apparatus. DANVILLE—Probable installation of two 4,000-kilowatt General Electric condensing turbine units with pumping plant for circulating water. GALESBURG—Probable installation of one 1,000-kilowatt engine unit, now condensing.

ROCK ISLAND, ILL.—The Tri-City Railway and Light Companies, D. G. Porter, assistant manager, Peoples Power Company will install 700 lightning arresters on all light and power transformers not already protected; necessary short primary and secondary extensions; build a 56-foot section gallery and power house addition to handle two turbos with maximum capacity of 25,000 kilowatts, already installed, and the present 4,800-volt transmission lines to substations in Davenport, Ia., and Rock Island and East Moline, Ill.

SPRING VALLEY, ILL.—The Spring Valley Utilities Company, R. W. Brown manager, expects to build about 20 miles of 33,000-volt transmission lines and 25 miles of 6,600-volt transmission lines, besides distributing lines in two small towns.

ADRIAN, MICH.—The Citizens Light and Power Company, J. H. Fee, president, contemplate installing a 1,000-horsepower water-softening plant, including feedwater heater and water meter; the installation of a 100-gallon-per-minute centrifugal deep-well pump for 80-100-foot head, and stoker for 250 and 500-horsepower boilers.

COPEMISH, MICH.—The village council is strongly in favor of installing an electric lighting system in the village under favorable franchise conditions. A committee was appointed with A. L. Gleason and others to investigate the best method of placing the proposition before the voters.

DOWAGIAC, MICH.—The municipal light and water plant, W. E. Reynolds, manager, will overhaul its present lines and may install a new direct-connected engine and alternating-current generator, 100 to 150 kilowatts.

HOLLAND, MICH.—The board of public works of this city has started a movement for a new power plant to replace the present one on East Fifth Street. The estimated cost of the improvement is $25,000.

LAKE ODESSA, MICH.—Woodland residents are planning on a system of electric street lights. Address the town clerk.

LANSING, MICH.—The Michigan Power Company, David R. Thomas, general manager, will make extensions amounting to about $10,000 in the station and about $20,000 on the distributing system in Lansing and vicinity.

MUSKEGON, MICH.—The Grand Rapids-Muskegon Power Company, W. M. Lewis, local manager, will probably make minor extensions to Lake Harbor, North Muskegon and to other contiguous territory, the outlook for new business being bright at this time.

JANESVILLE, WIS.—The Janesville Electric Company, P. H. Korst, president, will rebuild at once the Indian Ford plant which was destroyed by fire on February 23. Plans are being prepared by D. C. & Wm. B. Jackson, Chicago. The plant was not in operation when the fire started and the cause is unknown. The loss was complete. Mr. Korst hauled two 50-kilowatt transformers from Janesville to Indian Ford, over 10 miles of muddy road, using eight horses, and resumed service at Edgerton within 12 hours after the fire.

JOHNSON FALLS, WIS.—Plans for erecting a $300,000 hydroelectric generating station at Johnson Falls, Wis., were discussed recently at the annual meeting of the Wisconsin Public Service Company. The following officers and directors were elected: President, Clement C. Smith; vice-presidents, Ludington Patton and Henry L. Rice; secretary and treasurer, Howard Greene; assistant secretary and treasurer, George Allison; directors, George Allison, John I. Beggs, William Bigelow, O. C. Fuller, Howard Greene, J. W. P. Lombard, Ludington Patton, Henry L. Rice, C. R. Phenecie and C. C. Smith. The Wisconsin Public Service Company is composed of the Green Bay Gas and Electric Company, Green Bay Electric Railway Company and the Northern Hydro-Electric Power Company, High Falls, Wis.

MADISON, WIS.—The Madison Gas and Electric Company, F. L. Cross, general manager, will probably spend around $25,000 in betterments and extensions to its distribution system, and in the neighborhood of $50,000 in betterments and extensions to the generating plant.

SHEBOYGAN, WIS.—The Sheboygan Railway and Electric Company, Edward Hammett, manager, is asking for prices on the following equipment: one 500-kilowatt motor-generator set, 230 volts, direct current, to 2,300 volts alternating current, arranged to operate inverted if necessary; one 750-kilowatt motor-generator set, 2,300 volts, alternating current, three-phase to 650 volts direct-current, for railway, with Scott-connected transformers for three-phase from two-phase busbar; one 100-kilowatt, turbine-driven exciter unit, 125 volts, direct current, with Tirrill regulator, to control three exciter units simultaneously. Will also install a new submarine cable set under the Sheboygan River, 500 feet long, 30 feet below United States datum line, to consist of three 2,300-volt, four-wire cables, 0; two 650-volt cables for railway, 500,000 circular mils; two 5,000-volt cables, two-wire, No. 6, for street lamps.

AURORA, MINN.—A proposal is being considered for the construction of a light and power building in this village.

BEMIDJI, MINN.—The Warfield Electric Company is figuring upon building a five-mile pole line to Laomia.

CROOKSTON, MINN.—The City Council has appointed a committee to report on the electric light and water situation in the city. One of the first duties of the committee is to fix adequate rates under the provisions of the new city charter.

DULUTH, MINN.—The Duluth Edison Electric Company, C. E. Van Bergen, secretary and general manager, is contemplating the installation of a new 3,000-kilowatt frequency-changer set, with switchboard and accessories, some underground work and the regular ordinary line construction work.

DULUTH, MINN.—Articles of incorporation of the Minnesota Electric Light and Power Company were filed with the Register of Deeds of St. Louis County, Minn., February 23. The company is to be capitalized at $1,500,000, with shares at $100 each. The officers are A. C. Gillette, president; A. McC. Washburn, vice-president; and S. R. Henry, secretary and treasurer. These men, with J. A. Sinclair, C. A. Carlson, C. F. Lipcomb and Oscar Mitchell, all of the law firm of Bailey & Mitchell, Duluth, are the incorporators. Whether the company will construct an electric plant in Duluth and dispose of its power in competiton with the other firms already in the field, or has been organized to take over holdings already under some other name, has not yet been made known.

EVELETH, MINN.—A 10-year contract has been awarded to the Home Electric and Heating Company to furnish current for all lighting and the illumination of public buildings.

MANKATO, MINN.—The Consumers Power Company, R. E. Brown, manager, will make additions this summer, and will probably connect up into several nearby towns and villages. Mankato is negotiating an extensive "white way" system.

MONTEVIDEO, MINN.—The Montevideo Electric Light and Power Company has sold its plant to the Campbell Company of Huron, S. D. The consideration was $180,000, and possession will be taken by the new firm early in March.

ST. PAUL, MINN.—The City Council passed an ordinance February 25 providing for a municipal garage to cost $21,000. Councilman McCall, commis-

sioner of public safety, was directed to report on a site.

DUBUQUE, IOWA.—The Union Electric Company, E. M. Walker, general manager, has a few small projects under consideration that may call for extensions, which with new material for addition to light and power circuit will probably call for an investment of $30,000.

BARNARD, MO.—The citizens of Barnard, at an election held February 16, voted in favor of issuing a franchise for the installation of an electric system in the town. M.

KANSAS CITY, MO.—The contract for wiring and lighting the Coca Cola Building, a twelve-story concrete structure, has been let to the Squire Electric and Construction Company, of Kansas City. The work will be paid for as job work. M.

NEVADA, MO.—The Ft. Scott & Nevada Light, Heat, Water and Power Company, J. F. Schaefer, Jr., general superintendent, will install line extensions for new residence consumers and power load and special power lines for railway water pumping amounting to approximately $4,250; rehabilitation and changing distribution system from single-phase to three-phase, approximately, $3,650; a new street lighting system consisting of ninety-one 400-candlepower Type C Mazda lamps, Novalux pendent type fixtures, has been completed and is in very satisfactory operation.

SPRINGFIELD, MO.—Estimates and specifications for cable extensions to cost about $40,000 have been approved by the general offices of the Missouri-Kansas Telephone Company. Address R. G. Porter, district manager.

WHEELING, MO.—An electric lighting plant is to be installed here by Aza Lowe. M.

HARTFORD, S. D.—The local electric light and power plant wires are to be extended to furnish lighting and power facilities to Montrose. Arrangements for the work are already under way.

HIGHMORE, S. D.—At a mass meeting held by the citizens of Highmore it was decided to grant a franchise to O. V. Armstrong, of Appleton, Minn., for operating an electric light and power plant in this city. Forty street lights will be installed, and there will be 24-hour service. The plant will be in operation within 90 days.

SPEARFISH, S. D.—The Consolidated Power and Light Company, of Bellefourche, has purchased the city lighting system. The purchase was made from the Homestake Company which has been supplying Spearfish. The Consolidated lines from the power plant at Redwater pass through the edge of Spearfish so it will not be a difficult matter to transfer that city's lighting system from one company to the other.

FAIRBURY, NEB.—The city lighting plant, G. D. Myers, commissioner, contemplates a general overhauling of lines and equipment; the installation of 20 series street lamps, rebuilding and extension of transmission line and probably installation of motor-driven pump, 100 to 200 gallons per minute capacity.

LINCOLN, NEB.—The Lincoln Gas and Electric Light Company, O. R. Mallot, acting secretary, will do a little reconstruction on existing lines.

OMAHA, NEB.—The Union Company of Omaha, Willis Todd, secretary and treasurer, will build a new plant at Charlton, Ia., and about 25 or 30 miles of transmission lines connecting with that plant.

LEAVENWORTH, KANS.—A $15,000 contract for wiring and lighting fixtures for St. Mary's Academy, in new and old buildings, has been awarded to the Squire Electric and Construction Company, of Kansas City, Mo. M.

MANHATTAN, KANS.—The Manhattan Ice, Light and Power Company, E. A. Wright, manager, will probably install a new 500-kilowatt generating unit and a new eight-panel switchboard.

WASHINGTON, KANS.—The Concordia Electric Light Company has purchaser the Washington electric light plant, and will supply Washington with power from Concordia.

SOUTH CENTRAL STATES.

DANVILLE, KY.—The Danville Light, Power and Traction Company is planning extensions of its plant and additional machinery equipment, to supply the increased business it is handling.

DANVILLE, KY.—Work on the installation of the new electric light standards provided for on West Main Street has been begun. Lights are promised for early in March.

HAZARD, KY.—The purchaser of the local electric lighting plant was H. L. Stone, of Pikeville, Ky., who, with his associate, owns the plant at that place. Improvements will be made in the local plant, which has been out of commission since October, and service is promised for some time this month. During the interim the Beaumont Hotel has installed and put in operation a plant of its own and is furnishing service to its neighbors.

LOUISVILLE, KY.—The Jefferson County Electric Company, with an authorized capital of $5,000 has been incorporated here to do an electrical contracting business. The incorporators are J. A. Jakoby, Hoke Smith, John F. Boysen and Allen E. Smith.

NEWPORT, KY.—A municipal light and water plant to serve the cities of Newport and Covington Ky., which adjoin each other, is proposed by C. Ebert, commissioner of public safety of Newport. Electric current is now supplied in both cities by corporations. L.

BRISTOL, TENN.—The Bristol Gas and Electric Company, L. B. Morehouse, superintendent, is building a two-and-one-half-mile transmission line to supply the lighting plant at Bluff City, Tenn., and has in contemplation an extension of 15 miles to serve the town of Abingdon, Va.

JACKSON, TENN.—All electric wires in the fire district except trolley wires are ordered under ground in an ordinance which has just become effective here. The city itself, the Jackson Street Railway and Light Company, the Western Union Telegraph Company and two telephone companies are affected.

NASHVILLE, TENN.—The sum of $40,000 will be expended improving the city electric plant. Address Commissioner Andrews.

SEVIERVILLE, TENN.—The Walker Milling Products Company has purchased the Sevierville Electric Light and Power Company's interests here, and is extending the line to the dam of its mill two miles above Sevierville, where the power will be generated by water instead of steam. W. J. Savage has been here perfecting plans for the power plant.

GUNTHERSVILLE, ALA.—The town of Gunthersville is planning to put in a system of electric lights within the next few months. Address D. Isbell, mayor.

YAZOO CITY, MISS.—The Public Service Commission, Jas. S. Butler, superintendent, will rebuild about a mile of main lines in the city.

NEW IBERIA, LA.—The municipal waterworks and electric light plant, Lawrence F. Villermin, manager, is starting on a 500,000-gallon filtration plant, and expects to install about 300 water meters in May or June; also contemplates installing 40 more street lights, series type C Mazda, and an electrical coal carriage to unload coal.

CORNING, ARK.—At a special election held here to refer to a vote of the people a proposed electric light franchise sought by G. A. Booser, the franchise was granted, 171 for and only 28 against.

ABILENE, TEX.—A. V. Wainwright, vice-president, Abilene Gas and Electric Company, states that the company has contracted for and is about ready to install one 500-kilowatt Allis-Chalmers mixed turbine with C. A. Wheeler condenser and cooling tower; two 400-horsepower Heine boilers complete. The Okmulgee Ice and Light Company, of Okmulgee, Okla., is now constructing an eight-mile transmission line from Okmulgee to Morris, Okla. This company will also install one 400-horsepower boiler, already purchased. The Hugo Ice and Light Company, Hugo, Okla., will install a 500-kilowatt mixed Allis-Chalmers turbine with C. H. Wheeler condenser and spray system; one 350-horsepower Heine boiler complete. The Marshall Electric Company will build 14 miles of 13,200-volt transmission line from Marshall to Jefferson.

DALLAS, TEX.—At a meeting of the board of directors of the Texas Power and Light Company held here, the issuing of additional bonds to the amount of $250,000 was ordered. The proceeds will be used to complete the extensive impovements which the company is now making, including the construction of power plants at Paris and Waco. At the meeting the following officers were re-elected: J. F. Strickland, president; George S. Haley, vice-president and general manager; C. E. Calder, secretary and assistant treasurer; W. B. Head, assistant to the president. D.

HOUSTON, TEX.—The city will construct two municipal electric light plants here. Bids will soon be called for for the installation of the first one, which will provide lights for the several bridges and municipal buildings, and also power for operating some of the machinery of the water works plant. The second and larger plant will be located on the ship channel near the turning basin, and will be used to operate the wharf machinery on the municipal piers. The two plants will cost in the neighborhood of $75,000, it is stated. D.

SAN ANGELO, TEX.—The San Angelo Water, Light and Power Company, R. J. Irvine, vice-president and general manager, expects to do a good deal of general maintenance work on its lines and equipment.

THORNTON, TEX.—The City Council has granted a franchise to Houston parties for the construction of an electric light plant here. D.

WESTERN STATES.

DRUMMOND, MONT.—John D. Field, manager of the Royal Basin Min-

ing and Milling Company, of Maxville, Mont., announces that his company has decided to extend its electric transmission lines and to furnish power to the towns of Drummond and Hall, and to the ranchers in the valley along the route of the extension. O.

FORT BENTON, MONT.—It is reported the Montana Power Company, of Great Falls, Mont., through J. R. Hobbins, of that company, has purchased a controlling interest in the Fort Benton electric lighting system, and that the new owners will immediately overhaul the entire system, and install new electrical equipment. It is also reported that several extensions to contiguous territory and nearby towns will be made. O.

THOMPSON FALLS, MONT.—According to information, the Montana Power Company, of Great Falls, is preparing to put another dam about nine miles below here, and is contemplating constructing plants on two sites at points still further down Clarks' Fork of the river. The company is under contract to furnish power for the electrification of the Chicago, Milwaukee & St. Paul, and it is reported the company has entered into an agreement with the Northern Pacific Railway Company to furnish power for electrification. O.

LARAMIE, WYO.—The Intermountain Railway and Light Company, A. E. Anderson, manager, will install about two miles of line to near-at-hand ranches.

LA JUNTA, COLO.—The council is planning to install a $75,000 electric light plant.

TRINIDAD, COLO.—The Trinidad Electric Transmission Railway and Gas Company, Franklin P. Wood, manager, may, if mining industry improves, spend from $20,000 to $30,000 on extensions, and possibly $10,000 on replacements.

LEWISTON, IDAHO.—It is reported that the Lewiston-Clarkston Transit Company, of this city, will construct electric railway lines into Lewiston-Clarkston valley, from Lewiston to Orchard Tracts, thence to Asotin, through Clarkston, and to the Fair Grounds east of Lewiston. The company, which was recently incorporated, is capitalized at $500,000. A. G. Nortz, president of the Breckenridge National Bank, is president of the company. It is understood that work of making the extensions will begin about the middle of March, and that H. C. Hartung will supervise construction. O.

TOMBSTONE, ARIZ.—At a mass meeting held a few days ago, tax-payers moved to empower the City Council to proceed at once to make a contract with Phelps-Dodge to furnish electricity to the city.

ARLINGTON, WASH.—The Jim Creek Water, Light and Power Company has been petitioned by the Kelogg-Marsh Grange, representing farmers in the Marsh district, for the extension of the company's light and power lines to that district. According to reports the company will make the extensions this Spring. O.

SPOKANE, WASH.—According to announcements recently made by Harry A. Floor, president of the Trustee Company, work of installing an electric light, power and steam heating system in this city will begin within 60 days. It is planned to expend at least $300,000 in making the improvements. City Council last April granted this company the necessary franchises. O.

BAKER, ORE.—M. F. Newton heads the committee which is circulating a petition calling for an $80,000 bond issue election. The money derived from the sale of bonds is to be used in extending the present municipal lighting plant. Some time ago L. R. Stockman, engineer, estimated that approximately $80,000 would be sufficient to build an additional reservoir and enlarge the penstock and make other improvements sufficient to furnish electrical current to supply street lighting as well as business and residence lighting. The petitions are based on this report, and according to reports, sufficient signers will be obtained to call the election. O.

GRANTS PASS, ORE.—The Rogue River Public Service Corporation recently made application to the City Council for a franchise covering a period of 30 years, for the distribution and sale of electric current within the municipality for public and commercial use. The application for the franchise states that the current to be supplied in case application is granted will be generated at the company's property, the Golden Drift dam, three and one-half miles east of the city, and that this property will be electrically equipped this season, and in conjunction with the plant at Gold Hill, where the capacity is now being increased by 1,000 horsepower, the two connected with standard transmission line, will provide uninterrupted service to all customers. O.

SHERWOOD, ORE.—Harry Hart, of the Tualatin Electric Company, of Sherwood, is authority for the statement that the electric transmission lines of his company will be extended into the Pigard, Metzger and Greensboro districts, and that a system of street lighting will be installed in Tualatin at once. O.

LOS ANGELES, CAL.—The Council has granted to the Los Angeles Railway Corporation an extension of six months within which to complete its crossing on the Vermont Avenue line at Long Beach Avenue, where the main line must cross the four-track system of the Pacific Electric Company. The extension is granted because no definite policy has yet been agreed upon as to whether grade crossings or elevated or depressed tracks will be required.

PORTERVILLE, CAL.—Negotiations have been entered into between city officials and representatives of the Mt. Whitney Power Company in regard to the installation of an electrolier system in the business district. Plans and specifications are being prepared in the engineering department of the power company.

PROPOSALS.

COPPER TELEPHONE WIRE.—Sealed proposals for furnishing steel and copper telephone wires, brackets, insulators, barbed and barbless fencing to the Forest Service during the fiscal year, beginning July 1, 1915, will be received at the office of the Purchasing Agent, Forest Service, Ogden, Utah, April 6.

ELECTRIC PASSENGER ELEVATOR.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 25, for the remodeling of an electric passenger elevator in the United States postoffice and custom house at Albany, N. Y., in accordance with the specification, copies of which may be had at the office of the Supervising Architect.

ELECTRIC PASSENGER ELEVATOR.—Sealed proposals will be received by the Supervising Architect, Treasury Department, Washington, D. C., until 3:00 p. m., March 11, for the installation complete of an electric passenger elevator in the experimental station, Bureau of Mines, Pittsburgh, Pa., in accordance with the drawing and specification, copies of which may be had at the office of the Supervising Architect.

FOREIGN TRADE OPPORTUNITIES.

[Addresses and other information from the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch offices at Boston, New York, Atlanta, Chicago, St. Louis, New Orleans, Seattle and San Francisco. Write on separate sheet for each opportunity and give file number.]

NO. 15,684. ELECTRIC LAMPS.—An American business firm in New York has informed the Bureau of Foreign and Domestic Commerce that a representative of a group of Russian capitalists, who are interested in the exchange of commodities between Russia and the United States, wishes to communicate with American firms dealing in electric lamps. He also wishes to form commercial relations with American firms which may be interested in importing Russian products.

NO. 15,699. ELECTRIC MOTOR.—An American consular officer in a Mediterranean Sea city reports that a local electric-light company has requested him to secure full particulars, specifications, weights and measurements, price, c. i. f. destination, etc., for a 100-horsepower electric motor. Possible date of delivery should also be stated.

NO. 15,714. CENTRIFUGAL PUMPS.—An American consular officer in Europe reports that a business man in his district desires to represent American manufacturers of centrifugal pumps, particularly the self-contained type, operating by direct-current, 220-volt motors. Correspondence should be in Spanish.

NO. 15,749. WIRELESS APPARATUS.—A business man in Central America has informed a commercial agent of the Bureau of Foreign and Domestic Commerce that he is negotiating with one of the governments of Latin America for the installation of a wireless station. He wishes to receive offers, catalogs, prices, etc., from American manufacturers of wireless apparatus. It is desired to install a plant capable of communicating from 1,500 to 2,000 miles. He also desires an estimate on the installation of the equipment.

NO. 15,750. VACUUM CLEANERS.—An American consular officer in Spain reports that a business man in his district wishes to import vacuum cleaners. Catalogs and correspondence should be in Spanish.

NO. 15,763. MOTOR-DRIVEN BAND SAWS.—An American consular officer in Spain reports that a box manufacturer in his district is contemplating the enlargement of his plant, and will soon be in the market for large band saws. The machinery is to be driven by electric motors. Catalogs, prices, weights, etc., freights, and terms should be submitted at once. Quotations, etc., should be in francs, and should be c. i. f. destination or f. o. b. New York.

NO. 15,776. ELECTRICAL MACHINERY.—One of the commercial

agents of the Bureau of Foreign and Domestic Commerce in South America reports that the management of a cotton mill desires to electrify its entire mill. Plans, drawings, etc., of a modern oil-engine-driven plant should be submitted. It will require about 40 motors from 4 to 20 horsepower each. Correspondence may be in English.

NO. 15,784. ELECTRICAL SUPPLIES, HARDWARE, ETC.—One of the commercial agents of the Bureau of Foreign and Domestic Commerce reports that a large electrical supply house in South America wishes to get into communication with American manufacturers and exporters of kerosene, heavy oils, cement, electrical supplies, small lighting sets, cotton-mill machinery, telephones, water meters, shovels, hoes, and small implements. The firm is now representing American manufacturers of farming implements, and wishes to secure exclusive agencies.

NO. 15,793. ELECTRIC RAILWAY SIGNAL SYSTEM.—The Bureau of Foreign and Domestic Commerce is advised by one of its commercial agents that a railway and power company in Latin America desires to get into communication with American firms which may be in a position to supply electric railway signal apparatus. Catalogs and prices, etc., should be sent at once. Correspondence should be conducted in English.

NO. 15,784. ELECTRICAL SUPPLIES.—One of the commercial attachés of the Department of Commerce reports that an electrical company desires to be placed in communication with American manufacturers of electrical supplies with a view to representing them in a foreign country. Reference is given.

NEW PUBLICATIONS.

MINERAL RESOURCES.—The United States Geological Survey has issued "Mineral Resources of the United States" for the year 1913. This report comprises two volumes, devoted respectively to metals and non-metals.

METALLURGICAL SMOKE.—The Bureau of Mines, Washington, D. C., has issued Bulletin No. 84, entitled "Metallurgical Smoke," by Charles H. Fulton. This considers the injurious constituents, the methods of recovering them, and the legal aspect of the problem.

UNIVERSITY OF KANSAS.—Vol. 15, No. 1, of the *Bulletin of the University of Kansas* contains "The Organization and Work of the Engineering Experiment Station of the University of Kansas," by George C. Shaad, and "Vocational Education in Kansas," by P. F. Walker.

INSULATION RESISTANCE.—Scientific Paper No. 234 of the Bureau of Standards, Washington, D. C., is entitled "Insulating Properties of Solid Dielectics," by Harvey L. Curtis. This explains the methods and gives the results of measurements of both volume resistivity and surface leakage.

FIRING BOILERS.—The Bureau of Mines, Washington, D. C., has issued Technical Paper No. 80, entitled "Hand Firing Soft Coal Under Power-Plant Boilers," by Henry Kreisinger. A full discussion is given of the methods to be used to secure best results and efficient combustion. There are 32 illustrations.

NEW INCORPORATIONS.

CHICAGO, ILL.—The Sohm Electric Company, capital $50,000. To deal in electrical devices and equipment. Fremont Arnfield, Warren Pease and Luther D. Swanstrom are the incorporators.

NEW YORK, N. Y.—Light and Power Supplies, Incorporated. Electrical supplies, etc., Capital $3,600; incorporators: Sanford Smith, Samuel J. Miller and Raymond W. Bristol, all of New York City

CHICAGO, ILL.—Standard Electric Novelty Company; to manufacture and sell flashlights, cases, batteries, etc. Capital $25,000. Incorporators: Albert R. Dittman, Walter A. Rollert and Arthur Schneider.

OSWEGO, ORE.—The Oswego Lake Water, Light and Power Company has been incorporated with a capital of $5,000, for the purpose of installing a power plant and to furnish water to the city. Address A. S. Pattullo, incorporator.

PITTSBURGH, PA.—The National Lighting Products Company has been incorporated with a capital of $5,000. The incorporators are F. C. Murdock, George E. Lanz, Robert E. Gannon, Vincent T. Truxell, Pittsburgh, Pa., and W. E. Walsh, Dormont, Pa.

NEW YORK, N. Y.—Bethlehem Lamp Manufacturing Company, Incorporated. Electric lamps, etc. Capital $10,000; incorporators: Samuel Wiesenberger, South Bethlehem, Pa.; David Freiberger, Brooklyn, N. Y., Henry Freiberger, New York City.

COOPERSTOWN, N. Y.—The Wilson Automatic Call Company, Incorporated; to manufacture electric device and telephone systems, etc. Capital, $100,000. The incorporators are Walter E. L'Homadieu, James W. Wilson and James M. Lynch, all of Cooperstown, N. Y.

FINANCIAL NOTES.

At a special meeting of Edison Company of Boston stockholders voted to authorize a petition to the Massachusetts Gas & Electric Light Commission for authority to issue additional capital stock for extensions of plant. It is proposed to issue 20,480 additional shares to be offered stockholders for subscription on the basis of one new share for each 10 shares now outstanding.

Proceeds from the sale of $500,000 Middle West Utilities 10-year collateral sixes by the Illinois Trust, Russell, Brewster & Company and McCoy & Company, of Chicago, will reimburse the company for its development of subsidiaries. The only other funded debt is $3,500,000 three-year collateral notes. Bonds are limited to 75 per cent of outstanding capital stock. President Insull says: "The companies whose bonds are pledged for this issue show average ratio of net earnings to bond interest equal to 1.6. These bonds are secured by pledge of mortgage bonds on properties of subsidiary companies owned entirely or controlled by Middle West Utilities. The aggregate principal and aggregate interest on pledged bonds must always at least equal the aggregate principal and interest respectively of the 10-year six-per-cent collateral gold bonds. In addition, in order to assure the bondholders a continuity of management, there will at all times be pledged with the trustee for this issue or with the trustees of one or more of the mortgages securing the pledged bonds, a majority of the stock representing the control of each company, bonds of which are pledged."

Official announcement is made by Utah Securities Corporation of the acquisition of the electric light and power and street railway properties in Salt Lake City, and the electric light and power and gas properties in Ogden from the Oregon Short Line Railroad. Control of these properties is now vested in Utah Power and Light Company, the principal operating subsidiary of Utah Securities Corporation through the ownership of all the stock of Utah Light and Traction. Utah Power and Light, in addition to owning all the stock of Utah Light and Traction, has leased for 99 years, from January 1, 1915, the electric light and power and gas properties of the latter company, and earnings of Utah Power and Light from that date will include earnings of the leased properties. The electric railway properties will continue to be operated directly by Utah Light and Traction, and its surplus earnings will accrue to Utah Power and Light. Through the acquisition of Utah Light and Traction properties there have been added to Utah Power and Light 145 miles of street railway, five hydroelectric plants, with a capacity of 18,500 horsepower, a steam generating station with a capacity of 21,300 horsepower, 800 miles of transmission lines, and 28,608 electric light and power and 1,056 gas consumers. Earnings of Utah Light and Traction for the year ended December 31, 1914, were $2,769,835 gross and $868,190 net, with interest charges on all outstanding bonds of $762,670. Material economies will be made in the operating costs of Utah Light and Traction by the new management, especially through the consolidation of the lighting, power and gas properties with Utah Power and Light Company.

Dividends.

	Term	Rate	Payable
Blackstone Val. Gas. & Elec.	Q	2%	Mch. 1
Brooklyn Rap. Tran.	Q	1.5%	Apr. 1
Cal. Ry. & Pr. prior pref.	Q	1.75%	Apr. 1
Chicago Tel.	Q	2%	Mch. 31
Conn. Pr. pf.	Q	$1.50	Mch. 1
Con. G. E. L. & P., B. com.	Q	1.75%	Apr. 1
Con. G. E. L. & P. pf.	S-A	3%	Apr. 1
Galves.-Hous. Elec.	S-A	3.5%	Mch. 15
Galves.-Hous. Elec. pf.	S-A	3%	Mch. 15
Louisville Trac. com.	Q	1%	Apr. 1
Mackay Cos. pf.	Q	1%	Apr. 1
Mackay Cos. com.	Q	1.25%	Apr. 1
Manila Elec. R. R. & Lt.	Q	1.5%	Apr. 1
Montana Pr.	Q	0.5%	Apr. 1
Montana Pr. pf.	Q	1.75%	Apr. 1

Reports of Earnings.

AURORA, ELGIN & CHICAGO RAILROAD.

	1914	1913
December gross	$ 152,658	$ 168,956
Net after taxes	49,408	58,003
Surplus after charges	8,841	20,019
Balance after reserves	5,852	19,672
Six months' gross	1,097,375	1,137,190
Net after taxes	412,312	446,621
Surplus after charges	172,728	221,793
Balance after reserves	151,048	219,711

CALIFORNIA TELEPHONE & LIGHT.

	1914	1913
December gross	$ 10,281	$ 8,608
Net after taxes	4,280	3,161
Surplus after charges	2,218	1,316
Twelve months' gross	119,163	105,000
Net after taxes	48,328	41,925
Surplus after charges	25,673	22,054

UNITED RAILWAYS OF ST. LOUIS.

United Railways of St. Louis for the year ended December 31, 1914, reports earnings as follows:

	1914	1913
Gross earnings	$12,450,924	$12,702,644
Net after operating expenses and taxes	3,126,296	3,559,702
Interest charges	2,618,255	2,660,673
Surplus	508,040	899,029

FEDERAL LIGHT & TRACTION COMPANY.

Consolidated earnings of subsidiaries for the year ended December 31, 1914:

	1914	1913
Gross	$2,416,960	$2,372,174
Operating expenses and taxes	1,498,684	1,443,234
Net earnings	918,276	928,940
Administration expense.	29,623	36,640
Total income	888,653	892,300
Interest charges	586,155	531,787
Central Arkansas Railway & Light preferred dividend	84,000	63,000
Federal Light & Traction preferred dividend	*112,500	150,000
Surplus	105,998	147,513

*Only three quarterly dividends of 1.5% paid on Federal Light & Traction preferred in 1914.

COMMONWEALTH EDISON.

The report of the Commonwealth Edison Company for the year ended December 31, 1914, compares as follows:

	1914	1913
Operating revenue	$19,060,197	$16,838,743
Operating expenses & depreciation	12,008,640	9,504,427
Net operating revenue	$7,051,557	$7,334,316
Taxation and mun. compensation	1,492,266	1,353,915
Operating income	$5,559,290	$5,980,400
Other income	217,762	261,526
Total income	$5,777,052	$6,241,927
Interest on bonds	1,600,000	1,600,000
Dep. reserve	.....	544,000
Balance	*$4,177,052	$4,097,927
Dividends	3,534.652	2,816.864
Surplus	$642,400	$1,281,063

*Equal to 9.11 per cent on $45,838,936 capital stock, against 8.92 per cent earned on $45,838,936 previous year.

SOUTHERN BELL TELEPHONE.

The report of the Southern Bell Telephone Company for the year ended December 31, 1914, compares as follows:

	1914	1913
Gross revenue	$7,492,181	$7,028,199
Exp., tax., int., depr.	4,744,759	4,519,390
Net	$2,747,422	$2,508,809
Interest	1,104,617	844,891
Surplus	$1,642,805	$1,663,920

NORTHERN ONTARIO LIGHT & POWER.

The Northern Ontario Light & Power Company, Ltd., reports earnings for the year ended December 31, 1914, as follows:

	1914	1913
Gross	$875,195	$872,510
Net	664,172	658,407
Surplus after charges	390,812	386,145
Preferred dividends	142,758	142,758
Surplus	248,054	243,387
Previous surplus	316,441	129,652
Total surplus	564,496	373,039

VIRGINIA RAILWAY & POWER.

	1915	1914
January gross	$436,196	$441,823
Net income	237,228	243,941
Surplus after charges	99,508	108,531
Balance after depreciation	91,174	100,198
Seven months gross	3,068,902	3,060,941
Net income	1,648,668	1,647,030
Surplus after charges	700,384	708,803
Balance after depreciation	642,051	650,469

AURORA, ELGIN & CHICAGO.

	1915	1914
January gross	$144,145	$152,761
Net after taxes	47,848	49,428
Surplus after charges	8,045	10,119
Balance after depreciation	5,056	9,772
Seven months gross	1,241,520	1,289,951
Net after taxes	460,161	496,050
Surplus after charges	180,774	231,912
Balance after depreciation	156,104	229,483

PERSONAL MENTION.

MR. W. S. THOMAS, treasurer of the Wagner Electric Manufacturing Company, St. Louis, Mo., has been elected a vice-president of the company.

MR. WALTER ROBBINS, for many years assistant general manager of the Wagner Electric Manufacturing Company, St. Louis, Mo., has been elected a vice-president of the company.

MR. JOHN W. KELLY, city electrician, Camden, N. J., gave an interesting address on the "Marvels of Electricity" before the Loyal Order of Moose Lodge of that city on February 24.

MR. C. H. WEBB has acquired control of the Hudson & Middlesex Telephone and Telegraph Company, Perth Amboy, N. J., and vicinity, and become president and general manager of the company.

MR. B. C. McKENNON, of Shreveport, La., has been appointed manager of the plants and systems of the Arkansas Power Company at Arkadelphia, Ark., and will soon assume charge. He also will have charge of the plant at Malvern. Extensive improvements on the water and electric plants are in process.

MR. L. B. MARKS and MR. J. E. WOODWELL, consulting engineers, 103 Park Avenue, New York City, announce that they will dissolve partnership on May 1, 1915. Mr. Woodwell will locate his offices at 8 West Fortieth Street, where he will continue the general practice of consulting engineering and Mr. Marks will retain his offices at 103 Park Avenue and will specialize as heretofore in illuminating engineering.

MR. WILLIAM M. LEWIS, manager of the Grand Rapids-Muskegon Power Company, of Muskegon, Mich., was recently elected a director of the Muskegon Chamber of Commerce for a term of three years. Mr. Lewis has been connected with this company for about a year, previously residing in Connecticut, where he was general manager and vice-president of the Rockville & Willimantic Gas and Electric Lighting properties. Mr. Lewis is a past-president of the Rockville Chamber of Commerce.

MR. I. P. SPRAGUE has been engaged as New England manager for the H. & W. Accounting Bureau, with headquarters at 206 High Street, Springfield, Mass. Mr. Sprague was formerly connected with Pettingell-Andrews Company as traveling salesman. The Bureau has been organized by G. W. Hill, formerly special representative of the National Electrical Contractors' Association, and the organization will furnish a complete accounting system especially designed for the use of the electrical contractor.

MR. JIM O. CORBETT has joined the sales force of the Best Electric Company. Mr. Corbett was connected with the Economy Fuse & Manufacturing Company for a long time, and is well known through the Middle West. In his new position Mr. Corbett will travel through western Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, and Tennessee selling the well known line of "Best" sockets, attachment plugs, sign receptacles, etc. Mr. Corbett is a Jovian statesman-at-large and is well known, especially in the territory mentioned.

MR. E. M. BREED, who for the past eight years has been district manager of Canadian Allis-Chalmers, Limited, with headquarters at Vancouver, has been appointed district manager of the Pelton Water Wheel Company. He will continue his headquarters at Vancouver, B. C. Mr. Breed is a graduate of the University of Maine, College of Technology, and is a member of the American Institute of Electrical Engineers. Previous to becoming manager for the Canadian Allis-Chalmers organization, he was with the sales force of the Canadian Westinghouse Company at Montreal.

MR. CHARLES R. WINSTON, formerly president of the Winston Electric Construction Company, has been appointed by the Virginia Railway and Power Company as manager of its newly-created commercial department. Mr. Winston will have charge of all contracts, soliciting, canvassing, sale of electrical appliances, display and advertising. General Manager Buchanan's order appointing Mr. Winston, became effective last week. The creation of the new department, it is stated, is in line with a general policy of extension and for the purpose of developing further the commercial possibilities of the company's business.

MR. FRED W. GODFREY, formerly with Nagel & Company, of Toledo, O., and also formerly with the Bryan-Marsh Company, has taken a position as sales representative in the eastern part of the country with the Best Electric Company, Pittsburgh, Pa. Mr. Godfrey is well known in the electrical business throughout the states of Ohio and Indiana, where he has traveled for a number of years. Mr. Godfrey is looking after the sales of the Best Electric Company in New York, Eastern Pennsylvania, New Jersey, Delaware, Maryland, and Virginia. Mr. Godfrey is a statesman-at-large of the Jovian Order, and has a host of friends, particularly in the territory mentioned.

OBITURARY.

MR. JOHN C. McINNES, a member of the Board of Directors of the Worcester Electric Light Company, died February 24 at his home, 42 Harvard Street, Worcester, Mass. Mr. McInnes was long identified with the company and was active in promoting its progressive policy.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	Mch. 1	Feb. 22
American Tel. & Tel. (New York)	118¾	118¾
Commonwealth Edison (Chicago)	138¾	136½
Edison Electric Illuminating (Boston)	238	257
Electric Storage Battery common (Philadelphia)	48	*48
Electric Storage Battery preferred (Philadelphia)	48	*48
General Electric (New York)	139	141½
Kings County Electric (New York)	119	119
Massachusetts Electric common (Boston)	7½	7
Massachusetts Electric preferred (Boston)	44	—
National Carbon common (Chicago)	127	124
National Carbon preferred (Chicago)	119	—
New England Telephone (Boston)	—	136
Philadelphia Electric (Philadelphia)	23⅞	*24⅛
Postal Telegraph and Cables common (New York)	73	76
Postal Telegraph and Cables preferred (New York)	65¼	—
Western Union (New York)	62	62⅛
Westinghouse common (New York)	65	66¾
Westinghouse preferred (New York)	117	117

*Ex-dividend.

Heart failure was the cause of death. The deceased was 66 years of age.

MR. CHARLES B. GILLESPIE, of the New England Telephone and Telegraph Company's advertising department at Boston, Mass., died at his home in Weymouth Landing, February 25. He was born in Cambridge, Mass., in 1865, and was early engaged in newspaper work, writing histories of many New England cities and towns. This he continued up to 10 years ago, when he took up the work of advertising soliciting. He was a member of a number of secret fraternities. The widow and a daughter survive him.

DATES AHEAD.

"Made in the U. S. A." Industrial Exposition. Grand Central Palace, New York City, March 6-13. President, H. A. Cochrane, Fifth Avenue Building, New York, N. Y.

New England Section, National Electric Light Association. Question Box convention, American House, Boston, Mass., March 11-12. Secretary, Miss O. A. Bursiel, Boston, Mass.

Westinghouse Agent Jobber's Association. Hotel La Salle, Chicago, March 15-16. Assistant Secretary, H. P. Pritchard, East Pittsburgh, Pa.

Railway Signal Association. Annual convention, Auditorium Hotel, Chicago, Ill., March 15-18. Secretary, C. C. Rosenberg, Times Building, Bethlehem, Pa.

Electrical Supply Jobbers' Association. Spring meeting, Hotel La Salle, Chicago, Ill., March 17-19. Secretary, Franklin Overbagh, 411 South Clinton Street, Chicago, Ill.

American Institute of Electrical Engineers. Industrial Power meetings, Cleveland, O., March 18-19; Pittsburgh, Pa., April 15-16. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York, N. Y.

Minnesota Electric Association. Annual meeting, St. Paul, Minn., March 23-25. Secretary, F. A. Otto, St. Paul Gas Light Company, St. Paul, Minn.

National Association of Electrical Inspectors. Annual convention, Hotel Martinique, New York City, March 23-25. Secretary, W. L. Smith, Concord, Mass.

Electrical Committee, National Fire Protection Association. Annual meeting, New York City, March 24-25. Secretary, Ralph Sweetland, 141 Milk Street, Boston, Mass.

Mississippi Electric Association. Annual meeting, Hattiesburg, Miss., April 12-14. Secretary, H. F. Wheeler, Hattiesburg, Miss.

Iowa Section, National Electric Light Association. Annual convention, Keokuk, Iowa, April 20-22. Secretary, W H. Thompson, Jr., Des Moines, Iowa.

American Electrochemical Society. Annual meeting, Atlantic City, N. J., April 22-24. Secretary, J. W. Richards, South Bethlehem, Pa.

National Electric Light Association. Annual convention, San Francisco, Cal., June 7-11. Secretary, T. C. Martin, 29 West Thirty-ninth Street, New York, N. Y.

With the Electrical Manufacturers

The American Glass Specialty Company, of Warren, O., will manufacture a line of incandescent electric lamps and similar goods. The company was recently incorporated with a capital stock of $10,000, by J. E. Quackenbush, H. E. Quackenbush and others.

Heinemann Electric Company, Fifth Street and Girard Avenue, Philadelphia, Pa., has ready for distribution a new condensed catalog and price list of its switches, cutouts and rosettes. These are all made standard with porcelain bases, and are of varied assortment to meet a great many requirements.

The Robbins & Myers Company, Springfield, O., has issued Buletin No. 125, which describes and illustrates its type C direct-current motors. These are bipolar motors with cast-iron frames and range from one-eighth to three horsepower in size. They are made in various forms and either shunt, series or compound connection.

The Bristol Company, Waterbury, Conn., has issued Bulletin 192 describing the Bristol long-distance electric transmitting and recording system. This system was described in our issue of December 5, 1914. It is particularly useful for indicating and recording pressure, liquid level, temperature, etc., and transmitting the records electrically over distances as high as several miles.

The Draeger Oxygen Apparatus Company, 422 First Avenue, Pittsburgh, Pa., has issued a folder with many illustrations showing its well known Pulmotor, was most advantageously used in saving the lives of passengers overcome in the New York Subway accident of January 6, 1915. Important features of the Pulmotor are pointed out, and its utility for a variety of accidents shown.

Metropolitan Engineering Company, Forty-second Street Building, New York City, has ready new sections Nos. 3 and 5 for the loose-leaf binder of its publications; these sections supersede the former corresponding sections. Section No. 3 deals with service cutout boxes, and lists standard and special protective service cutout boxes and meter adapters, and various combinations of inclosed service switch, cutout and meter protective devices. Section No. 5 deals with meter-testing plugs; in this section are included 15 valuable charts showing meter-testing wiring diagrams.

The British American Company has established an international agency to undertake projects relating to engineering, the development of industrial organizations, realty operations and the management of industrial and financial enterprises, with offices in Chicago at the First National Bank Building; New York in the Empire Building, 71 Broadway; in Vancouver, B. C., Chihuahua, Mex., and London, England. The paid-in capital is stated to be $250,000. Thos. A. Frey, Chicago manager, announces that the personnel is composed of experts in the above mentioned fields of operation, these men being particularly well acquainted with the activities and trade conditions of the countries in which offices are located.

Hughes Electric Heating Company, 211 Schiller Street, Chicago, Ill., has had reprinted and is distributing copies of a paper prepared by F. M. Wilkes, of Poplar Bluff, Mo., entitled "The Electric Range." Mr. Wilkes is one of the central-station managers of The Light & Development Company of St. Louis. In this paper he gives the results of extensive trials with various types of electric ranges and shows that the Hughes range is the most practical and satisfactory type. The relative costs of electric cooking compared with use of gas and coal are given, also the other advantages obtainable only by the electric method. Original methods of introducing electric ranges are described that should make the paper of much value to central-station men.

Allen-Bradley Company, Milwaukee, Wis., has issued a new Bulletin B-7 that supersedes its former Bulletin B-7 to B-12. It deals with the current-limit type of direct-current automatic motor starter, ranging in size from 2 to 50 horsepower. The equipment and accessories are described in detail. An ingenious method of listing the six forms of these starters is used.

The Sangamo Electric Company, Springfield, Ill., has just closed a contract with the Pullman Company for several thousand ampere-hour meters. This is the second large contract for this type of meter given the Sangamo company by the Pullman company. As rapidly as possible, each and every Pullman sleeping and parlor car is being equipped with a Sangamo ampere-hour meter, to control the battery charge by the method developed by Ernest Lunn, chief electrician of the Pullman company. The application of Sangamo ampere-hour meters during the past year on hundreds of Pullman cars has resulted in greatly improved conditions of battery operation, and this improvement in turn is responsible for the Pullman company's decision to equip all cars in this manner.

The U. S. Light & Heating Company, Nigara Falls, N. Y., announces that the two suits by the Safety Car Heating & Lighting Company against the United States Company have recently been decided in favor of the de-

fendant by Judge Hazel in the Western District Court of New York. These suits were on the W. I. Thomson patent No. 881,743 of March 10, 1908, on a "dynamo suspension for car lighting," and W. I. Thomson patent No. 926,518, of June 29, 1909, on a "lighting system," commonly referred to as the carbon-disk regulator. In each case the patent was held invalid and the bill of complaint dismissed. The court held that the predecessors of the United States Light & Heating Company had installed dynamo suspensions and the carbon-disk regulator substantially as described and claimed in the patents, on their own apparatus on the New York Central Railroad prior to the dates of the patents.

The L. J. Wing Manufacturing Company, 352 West Thirteenth Street, New York City, maker of the Wing disk fan and of the Wing propeller-type fan, will place on the market shortly a complete new line of fans in all sizes, designed on the same lines as the Wing propeller-type fan. This line of fans has become very popular since its introduction, and the company states that it will shortly have ready for publication a selling proposition that will be especially attractive to contractors.

Harrison Safety Boiler Works, Philadelphia, Pa., has issued Cochrane engineering leaflet No. 17, which is a 20-page pamphlet, describing the Sorge-Cochrane hot-process system of softening boiler-feed water. This process is based upon the fact that chemical reactions are more rapid and complete in hot water than in cold water, and the precipitates are less soluble and coarser, so that they settle more rapidly. It is claimed that for these reasons more complete elimination of scale-forming matter is possible with an apparatus of a given size and with a given amount of excess reagent than if the water be treated cold, and that since the boiler feed water should be heated in any case, the hot process is the logical system to use for preventing scale in boilers. In the Sorge-Cochrane hot-process system the heating and chemical treatment apparatus are combined, the heater portion being similar to the Cochrane open-feed water heater. The water is first heated by exhaust steam while falling over trays, after which suitable chemical reagents are added as the water enters the reaction and sedimentation chambers, passing thence to the filters.

The Burnley Battery & Manufacturing Company, North East, Pa., announces that in the suit of that company versus the Doubleday-Hill Electric Company, on February 8, 1914, it was ordered, adjudged and decreed as follows: "(1) That as against this defendant the letters patent here in suit (No. 608,973, for soldering flux, dated August 8, 1898, to James A. Burnley, as assignee of William Burnley) are in all respects good and valid in law; that the plaintiff above named is the true and lawful owner of the said letters patent and all rights therein, thereto and thereunder; and that the defendant above named has infringed the said letters patent in its sale of two soldering fluxes called "Nokorode" and "Allen," respectively. (2) That an injunction issued out of and under the seal of this court perpetually restraining and enjoining the said defendant, its officers, agents, employes and workmen, from any further manufacture, sale or use of either of the soldering fluxes above mentioned, as well as from otherwise infringing the said letters patent here in suit and the exclusive rights of the said plaintiff thereunder. (3) That the said plaintiff do recover of the said defendant the cost of this suit to be taxed."

Record of Electrical Patents.

Issued by the United States Patent Office, February 23, 1915.

1,129,062. Mine Section Insulator Switch. G. H. Bolus, assignor to Ohio Brass Co., Mansfield, O. Sectionalizing trolley switch.

1,129,077. Suspension Device for Trolley-Wires and the Like. F. S. Denneen, assignor to Ohio Brass Co. Nipple for holding trolley ear is held on messenger wire by double clamp.

1,129,087. Telephone Receiver. E. Grissinger, Buffalo, N. Y. The magnet armature is suspended by wires stretched to high tension.

1,129,097. Electric Railway-Switch. G. Hyler and B. Herbison, Lansing, Mich. Electromagnetically moved switch tongue.

1,129,117. Arc Lamp. W. L. Patterson, assignor to Bausch & Lomb Optical Co., Rochester, N. Y. Feed for converging electrodes of projecting lamp.

1,129,120. Automatic Signal and Control for Railways. C. L. Pool, Sherman, Tex. Electric signal and train-stopping system controlled by third-rail circuits.

1,129,125. Incandescent-Light Guard. C. F. Rubin, Milwaukee, Wis., assignor of one-half to J. T. Hobson. Guard cage made of ring with spring arms.

1,129,126. Hot-Wire Electric Measuring Instrument. O. Schumann, assignor to Hartmann & Braun A.-G., Frankfort-on-the-Main, Germany. Hot strip in form of thin ribbon of relatively small length clamped to and extending between large supporting blocks.

1,129,143. System of Automatic Block-Signaling for Electric Railways. F. Townsend, New York, N. Y., assignor to General Railway Signal Co. A. C. signaling system.

1,129,147. Power System for Autovehicles. R. Varley, assignor to Varley Duplex Magnet Co., Jersey City, N. J. Electric motor starter and current generator.

1,129,181. Press Plate. G. W. Ehrhardt and M. Schiavon, Chicago, Ill. Has electric heating coils in porcelain tubes.

1,129,182. Heated Press Plate for Embossing. G. W. Ehrhardt and M. Schiavon. Modification of above.

1,129,202. Compressible Track Ramp. E. M. Jones, assignor to Jones Signal System Co., Atlanta, Ga. Depression of ramp closes a signal circuit.

1,129,205. Automatic Train-Stop. E. M. Jones, assignor to Jones Signal System Co. Includes motor-operated movable track ramp.

1,129,216. Ignition-Generator for Electric Starting Systems. A. L. McMury, Sound Beach, Conn. An ignition generator forms part of starting motor and is connected to ignition circuit only at start.

1,129,231. Transformer. L. T. Robinson and J. R. Craighead, assignors to General Electric Co. Instrument transformer with auxiliary reactance, winding adjoining secondary and in quadrature to it.

1,129,234. Igniter for Internal-Combustion Engines. M. P. Ryder, Springfield, Mass. Has two reciprocating armatures.

1,129,236. Warmer for Steering-Wheels. C. T. Schroyer, Sioux Falls, S. D. Has two electrically heated sections.

1,129,241. Electroplating Apparatus. C. N. Smith assignor of one-half to D. C. Cook Publishing Co., Elgin, Ill. Adjustable clamping connection to busbars.

1,129,263. Mechanical Time Switch for X-Ray Systems. W. A. Winter, East Orange, N. J., and R. Klett, New York, N. Y., assignors to Kny-Scheerer Co. Operated by spring motor.

1,129,271. Device for Sterilizing Medical Instruments. W. Boehm, Berlin, Germany. Electric heater closely fits about small instrument.

1,129,277. Connection-Protector and Trolley-Replacer. A. J. Conlon, P. J. Murphy and J. T. Tighe, Scranton, Pa. Guard for trolley frog.

1,129,285. Adjusting Device for Arc Lamps. L. Fort, Jersey City, N. J. Modified mast arm and lamp-raising device.

1,129,287. Electromagnetic Switch. S. E. Gamble, Petaluma, Cal. High-tension oil switch.

1,129,292. Electric Signaling Mechanism for Elevators. H. A. Humphrey, assignor to Safety Elevator Lock & Signal Co., Kansas City, Mo. Includes car and floor signals and circuits controlling them.

1,129,305. Car Signal. J. F. McElroy, Albany, N. Y., assignor to Consolidated Car-Heating Co. All of the series circuit-closers must be closed before the multiple circuit-closers become effective.

1,129,306. Process of Introducing Iron into Foods, Drugs, and Beverages. H. L. Marsh, Philadelphia, Pa. Includes final electrolysis with iron as anode.

1,129,307. Process of Forming Compounds of Iron and Carbohydrates. H. L. Marsh. Consists in passing electric current through solution of refined saccharose with iron as anode.

1,129,317. Telautographic Apparatus. G. S. Tiffany, assignor to Gray National Telautograph Co., New York, N. Y. Relates to the receiving-pan lifting and lowering means.

1,129,330. Converter. C. L. Cadle, assignor to Electric Railway Improvement Co., Cleveland, O. Each commutator segment has a narrow trailing segment connected to it through resistance.

1,129,257. Lightning Conductor for Telephone Lines. M. G. Mitchell, assignor to National-Standard Co., Niles, Mich. Telephone lightning arrestor connected with lightning rod.

1,129,358. Lightning Conductor. M. G. Mitchell, assignor to National-Standard Co. The distributer point has special base part for support and connection to lightning conductor.

1,129,377. Method and Apparatus for Protecting the Electrodes in Arc Furnaces. J. I. Bronn and W. Schemmann, assignors to Rombacher Hüttenwerke, Rombach, Germany. Consists in causing steam to impinge against the electrodes where they enter the furnace.

1,129,381. Electrical Heater. F. E. Carlson, assignor to Landers, Frary & Clark, New Britain, Conn. Special support for heating coils.

1,129,391. Means for Opening and Closing Doors. A. Höhne and H. Krake, Leibzig, Germany. Operated by electric motor.

1,129,395. Renewable Cartridge Fuse. H. M. Huxley, assignor to Economy Fuse & Mfg. Co., Chicago, Ill. Special means for tightly clamping ends of fuse element.

1,129,424. Wave-Modifier for X-Ray Systems. C. M. Peabody, South Orange, N. J., assignor to Kny-Scheerer Co. Commutator device.

1,129,425. Means for Automatically Stopping Railroad Motors. W. F. Pettes and A. E. Spicer, New York, N. Y., assignors to said Pettes. Semaphore-controlled electrical signaling, power-shut-off, and brake-control system.

1,129,438. Illuminating Device. H. Alexander, assignor to Alexalite Co., New York, N. Y. Indirect fixture with concealed lamp and corrugated reflecting bowl supported from within. (See cut on page 464.)

1,129,445. Contact-Maker and Interrupter for Ignition Systems. W. C. Brinton, Jr., Manoa, Pa., assignor to himself, and E. S. Philips. Has two interconnected contact disks.

1,129,446. Contact-Maker and Interrupter. W. C. Brinton, Jr., assignor to himself and E. S. Philips. Includes two levers, one operating the other.

1,129,447. Inclosed Fuse. W. J. Britt, Jr., assignor to Killark Electric Mfg. Co., St. Louis, Mo. Means for connecting renewal fuse element to knife-blade terminal.

1,129,459. Renewable Cartridge Fuse. A. L. Eustice, assignor to Economy Fuse & Mfg. Co., Chicago, Ill. The end caps are arranged for clamping the fuse element and providing helical venting passage.

1,129,460. Terminal Bushing. S. W. Farnsworth, assignor to Westinghouse Electric & Mfg. Co. Condenser-type terminal for high-tension apparatus.

1,129,463. Transformer. C. Le G. Fortes-

cue, assignor to Westinghouse Electric & Mfg. Co. High-tension winding with subdivided coils and an insulating structure comprising alternate layers of insulating and conducting materials, the layers of the latter being superposed and forming parts of connections between coils.

1,129,464. Transformer and Winding. C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. High-voltage coils are of graded widths, having the same length of mean turn and surrounding the intermediate core leg.

1,129,465. Transformer. C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. A metal sheath surrounds the winding and has a tubular projection through which the terminals extend.

1,129,466. Transformer Terminal. C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. Condenser-type terminal with cooling coil in center and top.

1,129,467. Terminal for Electrical Apparatus. C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. Modified form of condenser terminal for high-tension transformer.

1,129,468. Terminal Bushing. C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. Surrounding condenser-type terminal is an insulating structure shaped to conform to the electrostatic field.

1,129,469. Transformer. C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. Surrounding the high-tension winding is an insulating structure comprising interleaved insulating and conducting members, part only of the latter being connected to the coils.

1,129,470. Alternating - Current Transformer. C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. The high-tension coils are imbedded in and separated by an insulating sleeve surrounding the core.

1,129,471. Transformer Winding. C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. Has two groups of coils connected in series, in which pairs of coils from the two groups alternate in position.

1,129,472. Electric Current Transformer. C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. Modification of above.

1,129,473. Transformer for Electric Currents. C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. Conductors imbedded in the insulating structure have high resistance to limit capacity currents therein.

1,129,474. Transformer. C. Le G. Fortescue, assignor to Westinghouse Electric & Mfg. Co. Modification of above.

1,129,486. Insulating Structure. F. W. Harris, assignor to Westinghouse Electric & Mfg. Co. Insulating terminal bushing of modified condenser type.

1,129,499. High-Voltage Transformer. J. E. Mateer, assignor to Westinghouse Electric & Mfg. Co. Instrument transformer has low-tension winding surrounding an insulating sleeve; on this winding is an insulator supporting the top of the high-tension winding that passes through the sleeve.

1,129,500. Terminal Bushing. J. E. Mateer, assignor to Westinghouse Electric & Mfg. Co. Condenser type; has hermetically sealed jacket for the tapered end.

1,129,512. Electric Furnace. S. Peacock, assignor to International Agricultural Corporation, New York, N. Y. Resistance type furnace with stack-like chamber, oppositely disposed electrodes, and means for feeding the charge through chamber and withdrawing the finished product, also for feeding a gas through the chamber and withdrawing gaseous products, while maintaining the chamber gas-tight.

1,129,513. Process of Making Compounds in Electric Furnaces. S. Peacock, assignor to International Agricultural Corporation. Consists in passing predetermined quantities of conducting resistor material and charge material through the reaction zone, maintaining the voltage too low to permit arcing and regulating the current to produce required temperature.

1,129,520. Insulating Body for Electrical Apparatus. K. C. Randall, S. W. Farnsworth and C. Le G. Fortescue, assignors to Westinghouse Electric & Mfg. Co. Has its surfaces so shaped as to conform closely to the lines of force of the electric field.

1,129,521. Electrical Insulator. K. C. Randall, S. W. Farnsworth and C. Le G. Fortescue, assignors to Westinghouse Electric & Mfg. Co. Suspension insulator with external bell-shaped metal dome and pendent ball-headed hanger and insulating material between, shaped to conform to electrostatic field.

1,129,541. Electric Relay System. J. Bergman, Brooklyn, N. Y. Combination of messenger call boxes, relays, register and buzzer.

1,129,543. Automatic or Semi-Automatic Telephone-Exchange System. G. A. Betulander, Villa Castor, Sweden. Includes combining relays, selecting relays and selector switches.

1,129,553. Support for Electric Conductors. T. J. Cope, Philadelphia, Pa. Cable-rack bracket with special removable hook connection between inner bracket end and upright bar.

1,129,568. Electrical Switch. B. D. Horton, assignor to Detroit Fuse & Mfg. Co., Detroit, Mich. Armor-clad spring plunger switch, with external operating lever.

1,129,569. Electrical Switch. B. D. Horton, Detroit, Mich. Iron-clad service knife switch with special bearing for the handle at the side.

1,129,570. Locking Device for Switches. B. D. Horton. Inclosed reciprocating switch can be locked in open-circuit position.

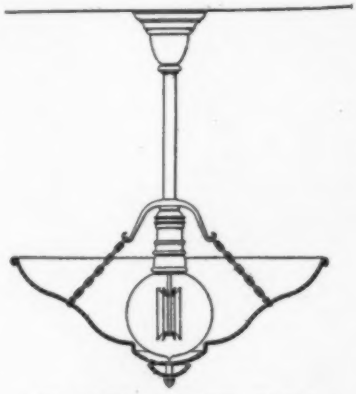
1,129,584. Magnetic Testing Device. T. J. Murphy, Rochester, N. Y., assignor of one-half to J. P. B. Duffy. Coils of test instrument connected like Wheatstone bridge.

1,129,602. Case for Portable Electric Lamps. C. H. Polland, assignor to Jennings Brothers Mfg. Co., Bridgeport, Conn. Case surrounds cell and has top aperture for lamp and switch at bottom.

1,129,603. Spark Plug. W. H. Quackenbush, Jamesburg, N. J. Details of construction.

1,129,614. Electric Stop Device for Knitting-Mahines. F. W. Sumner, Canton, Mass. Electrically controlled latch for holding the clutch in operating position.

1,129,628. Indicator for Electric Switches. H. H. Berry, London, England. A reflector is brought into raised position to reflect light when the handle is operated to close the switch.



No. 1,129,438.—Indirect Fixture.

1,129,632. Electric Sign. A. J. Brown, Chicago, Ill. Electric lamps within the casing.

1,129,690. Electric Storage Battery. K. Knobloch, assignor to Storage Battery Appliance Co., Baltimore Md. Between horizontal ribs of grid are connecting bars inclined toward a point above terminal.

1,129,700. Dynamo. M. S. Lysinger, Norristown, Pa. Has inclosed casing and supported shaft extenison for driving pulley.

1,129,728. Clock-Striking Apparatus. C. J. Rasmussen, Seattle, Wash. Striking of the clock gong closes electric alarm circuit.

1,129,757. Indicator for Snap-Switches. G. B. Thomas, assignor to Perkins Electric Switch Mfg. Co., Bridgeport, Conn. Rotary indicating disk.

1,129,777. Power-Transmission Gearing. V. G. Apple, assignor to Apple Electric Co., Dayton, O. For connecting electric starting motor to engine.

1,129,782. Cord Support. C. H. Bissell and D. C. Gidley, assignors to Crouse-Hinds Co., Syracuse, N. Y. For electric drop cords.

1,129,786. Burglar-Alarm. W. T. Bradshaw, Oakland, Cal. Special circuit-closer.

1,129,805. Signaling System. O. T. Lademan, assignor to Morse Code Signal Co., Milwaukee, Wis. Each substation has a step-by-step element operated by alternating current from the central station to control a circuit-changing element.

1,129,808. Switching Device. O. M. Leich, assignor to Cracraft, Leich Electric Co., Genoa, Ill. Telephone hook switch.

1,129,812. Electric Switch. D. E. Robinson, Enid, Okla. Double-throw lever-reciprocated sliding switch.

1,129,818. Negative Electrode and Process of Making the Same. W. Tassin, Washington, D. C. Composed of an intimate mixture of cuprous and cupric oxides.

1,129,821. Wireless Telegraphy. L. Tronchon, assignor to Compagnie Generale Radio-Telegraphique, Paris, France. Tuning through a combination of tight and loose coupling.

1,129,822. Magnetic Separator. G. Ullrich, assignor to Fried. Krupp Aktiengesellschaft, Grusonwerk, Germany. Includes a horizontal rotating cylinder and an underlying magnetic pole and disks serving as armatures thereto.

1,129,830. Water-Wheel Governor. J. Pearson, Somerset, Wis., assignor of one-half to J. F. Williamson. Electric control system governed by the generator load.

1,129,833. Signal Lamp. G. W. Koob, Montrose, Colo. Transparent rotatable panel with lamp behind the panel and means for projecting light outwardly from the axis of lamp rotation.

Patents Expired.

The following United States electrical patents expired March 1, 1915:

599,718. Plate for Accumulators. W. Majert, Grunau, Germany.

599,742. Apparatus for Visible Signaling. L. Sellner, Vienna, Austria-Hungary.

559,766. Insulated Railway Joint. P. Clark, Philadelphia.

599,789. Transformation of Alternating Currents Into Direct Currents. A. Müller, Hagen, Germany.

599,791. Electric Motor. O. H. Pieper and A. F. Pieper, Rochester, N. Y.

599,801. Toll-Collecting Device for Telephones. C. E. Scribner, Chicago, Ill.

599,803. Rheostat. S. H. Short, Cleveland, O.

599,804 to 599,806. Method of and Means for Controlling Electric Motors. S. H. Short.

599,807. Pneumatic Controlling Mechanism for Electric Railway Cars. S. H. Short.

599,810. Alternating-Current Motor. W. Stanley, Pittsfield, Mass.

599,815. Varipolar Motor or Dynamo. H. H. Walt, Chicago, Ill.

599,818. Electric Arc Lamp. E. P. Warner and H. H. Walt, Chicago, Ill.

599,828. Electric Railway. W. M. Brown, Johnstown, Pa.

599,832. Warp Stop-Motion for Looms. C. Crompton, Worcester, Mass.

599,862. Electrically Propelled Vessel. D. O'Flaherty, Kansas City, Mo.

599,867. Telephone Transmitter. J. H. Rogers, Bladensburg, Md.

599,868. Electric Car Trolley. W. H. Russell, Newcastle, Canada.

599,880. Electric Arc Lamp. C. Tepel, Bennett, Pa.

599,881. Magnetic Closer. J. N. Thomas, Johnstown, Pa.

599,891. Electric Contact Device. J. L. Buchanan, Johnstown, Pa.

599,892. Electric Regulator for Dynamos. W. H. Chapman, Portland, Me.

599,910. Incandescent Electric Lamp. J. T. Lister, Cleveland, O.

599,913. Electric Motor. E. McNerney, Pittsfield, Mass.

599,918. Motor Casing. S. H. Short, Cleveland, O.

599,929. Quick-Break Switch. H. P. Davis, Pittsburgh, Pa.

599,930. Switch for Electric Circuits. H. P. Davis, Pittsburgh, and E. F. Harder, Wilkinsburg, Pa.

599,931. Electric Arc Lamp. H. P. Davis and F. Conrad, Wilkinsburg, Pa.

599,932. Method of and Apparatus for Regulating Electric Motors. B. Frankenfield and D. C. Jackson, Madison, Wis.

599,940. Non-Synchronous Electric Motor. B. J. Lamme, Pittsburgh, Pa.

599,941. Direct-Current Electrical Machine. B. J. Lamme.

599,942. Inductor Dynamo. B. J. Lamme.

599,943. System of Electrical Distribution. B. J. Lamme.

599,947. Electrically Propelled Vehicle. P. R. Salberg, Pittsburgh, Pa.

599,954. Switch for Electric Circuits. G. Wright, Wilkinsburg, Pa.

599,975. Portable Electric Lamp. L. Paget, New York, N. Y.

600,037. Weighing Machine. F. H. Richards, Hartford, Conn.

600,057. Rheostat and Electric Heater. H. P. Ball, Brooklyn, N. Y.

600,058. Flexible Electric Conductor. A. Bournonville, Philadelphia, Pa.

600,063. Strain Insulator. H. Carmichael, Malden, Mass.

600,073. Telegraph Cable. J. J. Hall, Slough, England.

600,088. Current Collector for Dynamo-Electric Machine. G. W. Nell, Philadelphia, Pa.

600,092. Electrically Operated Hoisting Machinery. A. J. Shaw, Muskegon, Mich.

600,101. Supply System for Electric Railways. D. Urquhart and F. Wynne, London, England.

600,112. Electric Switch. J. J. Flint, Denver, Colo.

Electric Vehicle Section

ELECTRIC VEHICLE OPERATION—AN ACTUAL SERVICE STUDY.

By Arthur S. Wells.

The installation of large fleets of electric vehicles as a solution of delivery and transportation problems has, within the last few years, become so common and so admittedly successful that extended arguments in its favor are almost superfluous. Moreover, it is not the purpose of this article to debate the question from any point of view, but rather to give a general description, largely from an operating point of view, of a typical electrical vehicle charging plant and its operation.

The subject may be conveniently divided into five general headings as follows:

(1) Generation and distribution of current for batteries.
(2) The vehicles themselves.
(3) Batteries and related equipment.
(4) Garage organization.
(5) General conclusions as to cost, reliability, etc.

Generation and Distribution.

The current for charging the storage batteries may be generated directly by direct-current machines or converted from an alternating-current source by any one of a number of transforming or rectifying devices, the most common of which are the mercury-arc rectifier, the rotary converter, and the motor-generator set. The field of the mercury-arc rectifier is restricted more to small installations where only one or two cars are used, while for a large installation employing alternating current a motor-generator set or a rotary converter would be used.

The plant under consideration generated its own current for both lighting and power purposes throughout the factory so that no auxiliary generator or converter sets were necessary in the charging equipment.

The general layout of the plant in so far as the garage equipment was concerned was about as shown in the diagram herewith.

In the center is the packing and shipping room partly surrounded by a loading platform, about which the cars are ranged. From the main switchboard in the engine room current at 125 volts is led to the distributing panels and thence through charging rheostats to numbered charging plugs at each car station. Each one of these plugs has a correspondingly numbered switch on the distributing board and the car itself bears the same number so that the charging of 100 cars is a comparatively simple matter easily attended to by one man.

The condition of any battery on charge may be quickly determined from the meter readings at the distributing board at the expense of a few steps only. If, as the charging proceeds, the successive readings indicate that some particular battery is not building up as it should then a close range examination of the battery itself, and if necessary, of the individual cells, may be made.

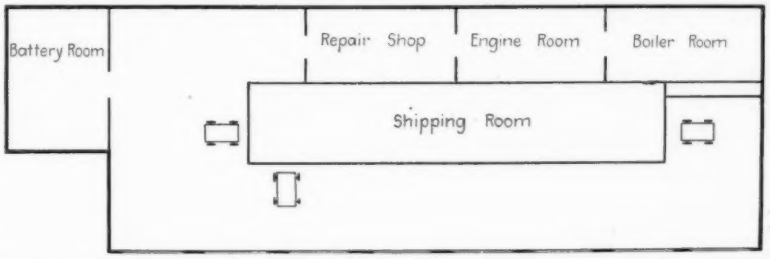


Diagram Showing Layout of Garage Equipment and Relation of Loading Platforms to Facilities for Housing Electric Vehicles.

Vehicles.

Electric cars, of course, like gas machines, vary widely in details of construction according to the manufacturer so that only a bare outline as to motors, control and general equipment can advantageously be given.

A car typical of those that one company was using two years ago will be selected as an example. This vehicle was driven by two series motors of about one and three-quarters rated horsepower each at 85 volts through gears to a counter-shaft and thence through roller chains to the rear axle. The use of a differential is of course unnecessary with such an arrangement.

The gear drive on the counter-shaft has been found to wear out quickly and, on the whole, to give unsatisfactory results so that on some of the newer cars a silent chain was substituted with a consequent saving for repairs and smoother operation. All motors are designed to carry 250 per cent overload current and will stand rough usage.

The controllers used are of the drum type giving, usually, four speeds ahead and two reverse. This simple and flexible speed control is one of the most noteworthy features of the electric.

Such a car with a load rating of from 1,500-2,000 pounds would, including body, motor and battery, weigh in the neighborhood of 5,000 pounds, so that with only three and one-half horsepower no great speed can be expected, and in fact the manufacturers only guarantee from 10 to 12 miles per hour on hard level roads for cars of this type, with still lower ratings for heavier machines.

Of course, you might say, "Why not use a motor of higher voltage and thus gain in power without adding any weight?" But it must be remembered that in order to add two volts at the motor terminals we must increase the weight of battery over 40 pounds so that any appreciable increase in voltage will result in a prohibitive increase in battery weight. The Edison cell has a considerable advantage in this respect but still is too heavy to permit the employment of higher voltages.

Batteries.

The most important item in the entire system, both from the financial point of view and from the standpoint of continuous operation, is probably the installation and care of batteries. Perhaps the best method of discussing batteries will be to take the unassembled details as they come to the battery room from the manufacturer and follow out the various steps in their preparation and service.

Batteries can of course be bought assembled and ready for use, but in the case of a large installation where a competent battery man is employed it is very much cheaper and fully as satisfactory in every way to purchase the unassembled plates and jars and do the assembling in the garage.

When storage batteries first came into use for vehicle work it was customary to use for each cell a comparatively small number of thick plates because it was thought that thin plates, in spite of their known advantage as regards capacity, would buckle and shed their active material in the strenuous service required of them in vehicle work. Later developments, however, have made it possible to use plates as thin as nine-sixty-fourths of an inch, 21 plates to a cell, with a consequent large increase in ampere-hour capacity as well as a higher average voltage during discharge.

A very common size of plate for vehicle work is the Philadelphia W. T. or its equivalent, using 19 plates per cell, 10 negatives and nine positives. As the plates are received the terminal lug is considerably longer than necessary in the assembled cell.

The method of binding the plates together is to place them in a sort of jig especially designed for the size of plate used, having, around the lugs, a cavity of the proper shape into which molten lead may be poured, thus binding the plates together into groups of nine, for the positives, and 10 for the negatives; or 10 and 11, as the case may be.

Before this process can be carried out, however, each lug must be cut to the length required to fit the jig and the coating of oxide removed by scraping, thus leaving a clean surface to which the lead binder will adhere. The cutting may be done in a number of ways, but perhaps the simplest is to use an ordinary fine-toothed carpenter's saw. One sharp stroke of the saw and a smart blow will break the lug cleanly so that if a stop is used to automatically fix the length, very quick, as well as accurate, work can be done.

When the plates have been cast together in the jigs the next step is the process of "burning." This is done with a small oxy-hydrogen jet flame by means of which all irregularities in the cast binder are melted down, the edges smoothed over and the ends of the lugs firmly soldered to the binder. Defective castings may be patched up by the use of the jet when otherwise nine or 10 expensive plates would be a total loss.

Binders may be bought ready made which only need to be inserted over the ends of the lugs and burned, but the casting method makes possible the use of scrap lead from discarded batteries and hence results in a considerable saving.

The next step is the placing of the separators between the plates and assembling them in hard rubber jars when they will be ready for the addition of electrolyte and the initial charge. Basswood separators from three-thirty-seconds to three-sixteenths of an inch thick, with corrugations running lengthwise, are most commonly used for vehicle work. This type of separator lasts fully as long as the plates themselves and when properly cured gives no trouble. They are, of course, cheaper than either rubber or glass and more rugged than the latter. If, however, the acetic acid which is present in all woods has not been completely removed it may be released at high temperatures (100 degrees Fahrenheit or more) and in a short time ruin the cell by local action. A number of years ago one garage had serious troubles with its batteries. They began to lose capacity at an alarming rate and in spite of heavy overcharges cars were stranded day after day for lack of power on runs that they had formerly been making without difficulty. After weeks of unrewarded trouble hunting on the part of the garage force, the battery manufacturers were appealed to. For a time they, too, were puzzled, but a chemical analysis of the separators then in use disclosed the presence of acetic acid. A new lot of separators soon relieved the trouble.

It is interesting to note that the heavy overcharges that the batteries had been receiving probably only aggravated the trouble because the higher temperatures thus set up in the cells was freeing more and more of the injurious acetic acid and thus hastening the destruction of the battery.

Most cars employing lead-cell batteries run on 42 cells, thus assuring an average voltage of about 80. Forty-two cells assembled in one unit, however, would weigh about 1,600 pounds, so that the battery is usually divided into two units of 21 cells, each in a box of anti-acid treated wood. The specific gravity of electrolyte as first added is, for vehicle work, from 1.24 to 1.25, somewhat higher than for stationary service. Excessively high densities are ruinous to the negative plates, while very dilute acid causes sulphation and seems to have in addition a corrosive effect.

Before permanent installation in a car, the new battery is first charged in the battery room and the action of each individual cell carefully watched throughout the entire charge, readings of the specific gravity and voltage being periodically taken. After installation the battery does not, of course, receive such detailed care. Its time of charge is then regularly 10 hours at an average rate of about 35 amperes. Upon the care with which the charging is done largely depends the life of the battery, so that the work should be in charge of a competent man.

A great increase in life is claimed for the "no-gassing" charge. Under this system each daily charge is begun at the normal discharge rate and so continued until gassing commences. The rate is then reduced in several steps keeping always below the gassing point, until the finishing rate is reached, when gassing will be so slight that it can do no harm. The charge is then continued until the total battery volts has risen to within about two volts of the maximum attained on the last previous overcharge.

Once a week the battery is given an overcharge at the finishing rate until voltage and specific gravity have stopped increasing for from two to four hours. The object of the overcharge is to prevent any serious amount of sulphation. At wider intervals, say every two months, the battery jars are thoroughly cleansed and all sediment removed from the bottom.

Gassing, as it is called, is due to the inability of the charging current to find lead sulphate. Whenever there is any excess of current over the amount to which sulphate is readily accessible, this excess dissipates its energy in breaking up the water of the electrolyte into gasses and thus does no useful work. With thick plates the prevention of gassing is practically impossible, but when thin plates are used, as is always the case in vehicle work, the active material is more readily accessible and gassing may, with the exercise of a little care, be practically eliminated, with a consequent increase in battery efficiency.

The importance of this is clearly shown by the statement that one plant claims to have reduced its monthly power bill from $800 to $600, or 25 per cent, by the use of careful charging methods and the elimination of gassing.

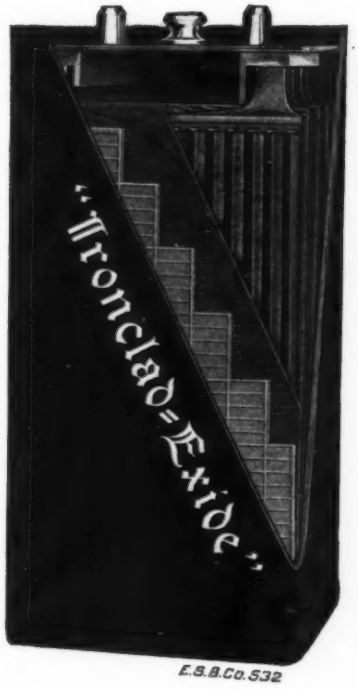
From some figures obtained in a plant where no unusual attempt at efficiency was made the ratio of ampere-hours input to output was found to be from 230/350 to 270/350, or from 66 per cent to 77 per cent watt-hour efficiency at the switchboard (including losses in the rheostats and leads) may be as high as 70 per cent, while that of the battery alone is often 80 per cent, 10 per cent being lost in the rheostat.

One battery company claims an average life of 16 months for their

"Ironclad-Exide"

The Battery for Commercial "Electrics"

"DOING ITS DUTY EVERY DAY"



The "Ironclad-Exide" Battery is in its fifth year of successful service. Its record for the past four years stands as absolute proof of the correctness of its design.

It is unquestionably the battery for commercial service. It is reliable—day-in and day-out—every day in the year. No delays—no fuss—no inconveniences. *Always dependable.*

It is the battery for big loads—rough or hilly roads—*hard service.*

The "Ironclad-Exide" Battery hauls the most for the longest time with the least trouble and at the least expense.

It is economical to use and economical to maintain. *It's good when new and it stays good.* It's a business battery for business men.

It is used by the largest electric vehicle users in the country.

It is the battery for Central Stations to endorse. It makes friends—it saves regrets.

These are our claims for the "Ironclad-Exide" Battery. More convincing, however, is *"what the other fellow says."* Get a copy of the new "Ironclad-Exide" testimonial book. It contains letters from vehicle owners who have used one or more "Ironclad-Exide" Batteries for three years or over.

THE ELECTRIC STORAGE BATTERY CO.

Manufacturer of

The "Chloride Accumulator", The "Tudor Accumulator"
The "Exide", "Hycap-Exide", "Thin-Exide" and "Ironclad-Exide" Batteries

New York Boston Chicago Washington **PHILADELPHIA, PA.** Denver San Francisco Seattle St. Louis
Cleveland Atlanta Pittsburgh Detroit **1888-1915** Rochester Los Angeles Toronto
886 "Exide" Distributors 12 "Exide" Depots "Exide" Inspection Corps

batteries in ordinary service. In one actual installation under the hardest kind of service, the average life is about 14 months, so that the claim of 16 months seems reasonable enough. The true measure of battery life is, of course, the actual number of charges and discharges it stands up under.

In connection with batteries it might be stated that the battery room should fulfill a few simple but, in the main, important qualifications which are enumerated below.

(1) There should be good ventilation, if necessary by means of fans.

(2) No iron work should be used on any of the fittings.

(3) A lead-lined or glass tank should be provided for mixing the electrolyte.

(4) The room should not be located near a source of ammonia, such as a stable or refrigerating machine.

This latter precaution, although given by a prominent writer on the subject, may not be very important as the following example shows: A battery room, where the batteries for about 50 cars were handled, was bordered on one side by a stable and on the other by an ammonia compressor, and in spite of the fact the walls were hardly more than thin board partitions no troublesome effects were ever observed.

Organization.

Thus far a description of the three essential elements of the plant has been given. The next step will be to outline a scheme of organization and illustrate its workings. The garage force is divided, by the Ward Motor Car Company, in its scheme of organization, into four headings, as follows: Washing and polishing department; Inspection and repair; Battery charging and repair; Power.

The system further provides for a cost keeping system by means of three sets of records: Daily car report card; Monthly report card; Parts renewal card.

The daily report card is kept by the operator himself until he is through for the day. It then has entered his name, car number, number of trips made, total mileage and condition of car when turned in. In addition, all accidents, no matter how unimportant, are supposed to be noted.

The monthly card contains a summary of the total costs and mileage on one car for the given period. This may be for one month or any other convenient interval, depending usually on how often the concern closes its books. The items included are vehicle condition, battery number, power cost, accident cost, total cost and route number for each working day of the period.

The parts renewal card gives a comprehensive report of the life of the various parts and is also an effective check on the garage force and the manufacturers of parts as well.

In order to illustrate the workings of the system a typical working day will be outlined beginning when the cars leave for the first trip in the morning and ending when they are ready for the following day.

In the baking plant from which most of the accompanying illustrations were drawn the cars left on the first trip at about 3 or 4 a. m. The routes would probably vary between a total of 15 and 50 miles, the shorter ones being made twice a day, so that the average mileage per car was perhaps 30. The short-trip cars usually returned about 10 a. m., when they were given a short boosting charge for about two hours before leaving on the afternoon trip.

The effect of boosting on the life of the battery seems to be a matter of discussion, but if the boosting charge be carried on at such a rate that excessive heating does not occur no harm should be done. That is, if a battery will give a certain number of charges and discharges when not boosted, it should give the same number with boosting, considering each boost as a charge. As a matter of fact, however, it is probable that boosts as ordinarily carried out are somewhat harmful because they are hurried and excessive current rates are employed, so that the battery is very often overheated and gassed abnormally. Boosts are, however, unavoidable with certain types of service and a few cents loss in battery life may save a dollar for towing in dead cars.

But to continue the day's routine; about 3 p. m. the cars begin to come in from their last trip, the first ones being the "long trippers." As each one passes through it is washed down and polished if necessary and then passed directly to its station where it is put on charge. If any car is held up on the road by accident or a weak battery a reserve car or gas machine is sent out to tow it in. In the meantime all the returning cars are inspected and the operator's card examined to see whether any repairs are needed. If so they are immediately begun, if possible, or provisions made for the substitution of another car if the repairs required are too extensive for immediate completion. In any case the equipment is carefully checked up, especially the motor commutators. Consistent and careful attention to commutators with frequent sandpapering will save many a burned out motor.

The batteries also receive their share of attention. The electrolyte is always kept above the tops of the plates by the addition of distilled water and the condition of the batteries occasionally checked up during the process of charging, which lasts about 10 hours.

By the time the car is ready for the next day's run the daily record card has been completely filled out, turned over to the office and a clean card put in its place.

The duty of the power department is to have always available at the charging plugs, a supply of power sufficient for all the needs of the garage, but beyond that point they are not held responsible for any of the equipment, it being under the jurisdiction of the garage superintendent.

Of course record cards are not used in a great many large installations and conditions of service vary widely with different kinds of business. Furthermore, in planning any scheme of organization it is very often advisable to design the organization to fit the men available rather than to arbitrarily choose a type organization just because it has worked well somewhere else. However, the general outline of equipment and daily routine will in any case be about as described in the previous pages.

Cost and Reliability.

A study of the available data on operating costs seems to admit of only one conclusion; viz., the substitution of electrics for horse equipment will, except possibly under some very unusual conditions, result in a very substantial saving, as well as a vastly increased service efficiency.

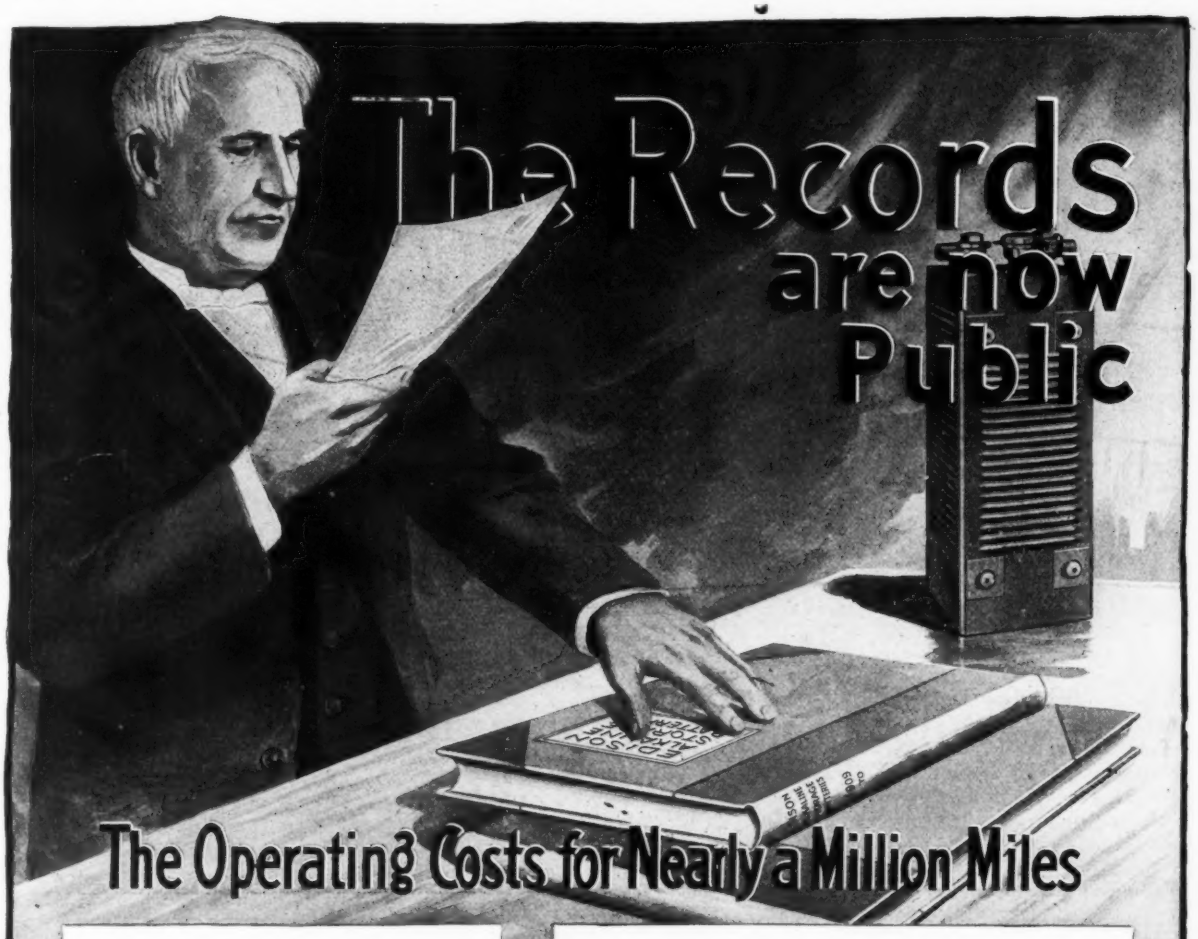
In considering data of this nature though, as in nearly all other business or engineering problems, it must be borne in mind that every problem has its own peculiar features that do not admit of a general solution.

The most thorough study of this subject yet attempted is that of the Massachusetts Institute of Technology, begun several years ago and still under consideration. For their preliminary investigation they divided vehicle traffic into two divisions: light work, such as parcel delivery, and heavy trucking. After collecting material from a great many sources cost data were compiled that indicated a decided saving for the electric car over both gasoline and horse equipment. These figures coming, as they do, from an entirely unbiased source, of considerable authority, are very convincing.

There are, however, many other sets of published data from investigations, many of them very exhaustive, practically all of which show the electric to be decidedly more economical.

The Waverly Company ran a five year test on gasoline, horse and electric equipment and reached the following conclusions:

Daily cost—Horse equipment, $5.41; gas equipment, $4.25; electric equipment, $2.96. Saving over horse equipment 45.2 per cent.

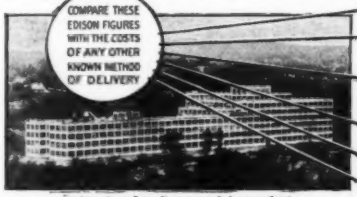


The Operating Costs for Nearly a Million Miles

I CLAIMED that the **New Alkaline Storage Battery** would make the Electric Vehicle the cheapest means of Street Transportation, but I had only my private tests to satisfy me. Today thousands of Edison Batteries in thousands of **Trucks** and Delivery Wagons are making Operating Records that are easily investigated by all. After the four or five years of hard service that many of these vehicles have had, is it possible to deny that my claim is proved?

Thomas A. Edison

HERE IS ONE RECORD—A REPORT—ON 22 FIVE-YEAR-OLD EDISON BATTERIES



The Edison Storage Battery Plant at Orange, N. J., was not affected by the fire in the Edison Phonograph Works on December 9th

Write for Bulletins on the use of **Edison Batteries** for Lighting Country Houses, Ignition and Lighting of Gasoline Cars, Yacht Lighting, Railway Train Lighting and Signaling, Telephone, Telegraph and Wireless *and High-priced or Low-priced Passenger Electrics.*

Edison Storage Battery Company
Orange, New Jersey

Distributors in New York Chicago Boston Cleveland Washington San Francisco Los Angeles Portland, Oregon Seattle

ADAMS EXPRESS COMPANY
242 WEST 47TH STREET

MOTOR VEHICLE DEPARTMENT
GEORGE STEVENS
Superintendent

New York, December 7th 1914

Edison Storage Battery Company,
Orange, N. J.

Attention of
Mr. A. Bachman,
V.P.& Genl Mngr.

Gentlemen:-

Thank you for consenting to extend from five to six years the conditions of your guarantee regarding renewal of positive plates.

The average operating cost per battery per month of the twenty-two trucks at Indianapolis, equipped with Edison Batteries in November 1909 and averaging about 660 miles per month, is as follows:-

YEAR	BATTERY MAINTENANCE (Refilling, new solution, watering, cleaning, all repairs, inspection, etc.)		CURRENT (Purchased by meter)	TOTAL
	Material	Labor		
1910	$3.47	$4.10	$10.05	$17.62
1911	3.41	4.10	8.93	16.44
1912	3.41	4.10	9.90	17.41
1913	2.86	4.10	8.17	15.13
1914(to Oct.31)	3.11	4.10	9.50	16.17

The average total operating cost per battery per month has, therefore, been $16.55 for a period of five years. In this time the average mileage per truck was about 40,000, which reduces the operating cost to $.08½ per mile. The batteries are still in service.

Yours very truly,
Geo. Stevens

GS-REW

Electric Bus Operated in Chicago by the Fashion Auto Station.

Electric Bus Line in Chicago.

As an outgrowth of the recent agitation in Chicago for "jitney" buses to supplement the regular transportation service, a bus line has been established in one of the residential sections of the city, in a locality not now served by any other means of transportation.

The Fashion Automobile Station, operating two electric vehicle garages—one at Fifty-first Street and Cottage Grove Avenue and one at Fifty-first Street and Lake Park Avenue—inaugurated the service, originally with the idea of affording its patrons a means of conveniently going from either garage to their homes or the elevated or railway stations, but the service will also be available to the public. Schedule trips will be made during the rush hours in the morning and evening and stops will be made at any points along the route to take on or let off passengers.

The bus, shown in the accompanying illustration, was constructed in the shop of the Fashion garage, the chassis being a Woods Motor Vehicle Company Model No. 10. The battery equipment comprises 40 cells of lead battery. Ten passengers can be carried conveniently. The speed when fully loaded is 12 miles per hour and when empty 18 miles per hour.

Electric Truck for Animal Rescue.

The Massachusetts Society for the Prevention of Cruelty to Animals has in service a low-hung, covered truck for the transportation of horses and other large animals from points about Boston to the Society's new animal hospital on Longwood Avenue. The vehicle is by the Commercial Truck Company, of Philadelphia, and is of three-tons capacity. The battery is of the Philadelphia Storage Battery Company manufacture and consists of 44 cells, located in a compartment under the driver's seat. Two motors, geared to the front wheels, are the motive agency. The floor of the truck is about 12 inches above the ground, and the high tailboard can be lowered to the street to provide an easy incline for a sick horse to walk into the pen. A hand-operated winch is provided for gently drawing in an animal that may be unable to go upon its legs.

The truck makes trips daily to points within a 10 or 15-mile radius, going to suburban towns such as Milton, Newton, Quincy, etc.

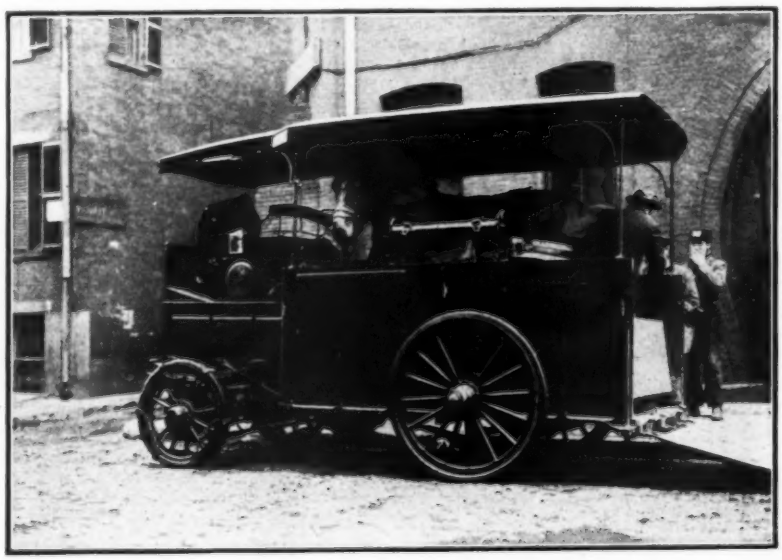
An electric garage is a feature of the new hospital, which opened about February 15. This is located on the street floor, in a corner of the building adjacent to Longwood Avenue. The main entrance which penetrates the structure fronting the street gives access to a courtyard about which are ranged the "wards" and operating rooms.

The garage is provided with Cutler-Hammer unit-sectional charging panels in duplicate. Energy is obtained from the plant of the Havard Medical School near by.

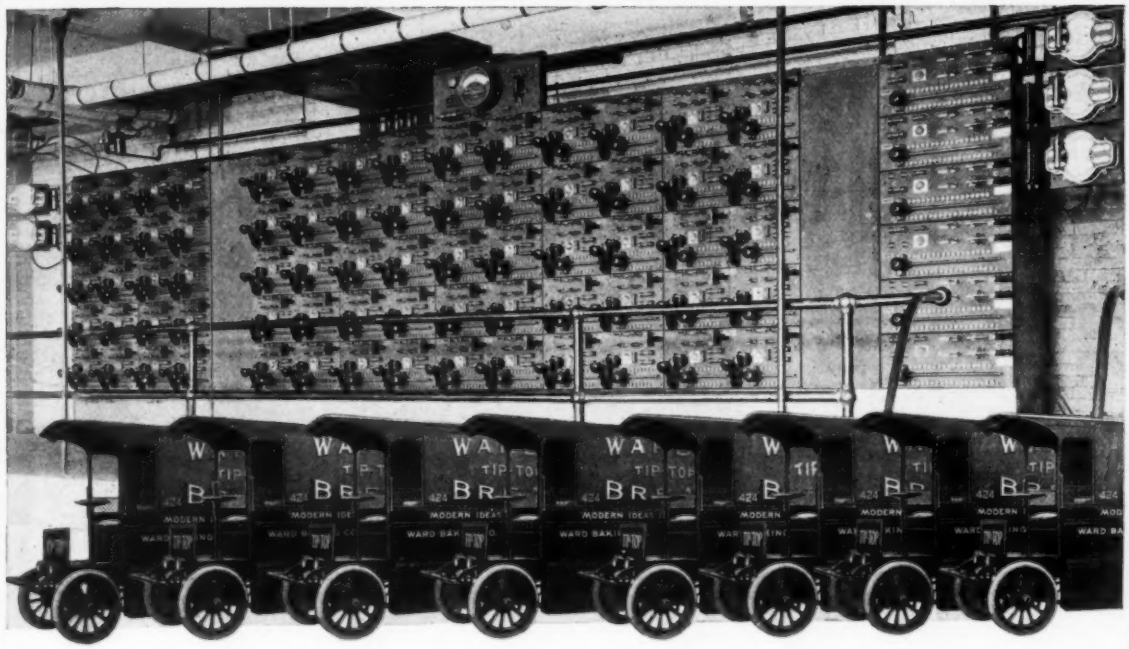
The Electric Taxi-Cab.

In discussing the possibilities of the electric vehicle for taxi-cab service, Albert Jackson Marshall, executive secretary of the Electric Vehicle Association of America sums up many points in its favor. Of especial interest is the record of the electric in Detroit, Mich., where it has been tried out by the Detroit Taxicab and Transfer Company. In substance the story is as follows:

After much experimentation, a model was finally evolved, and in order not to raise expectations which might be disappointed, this car was put to severe tests without any mention of it being made. For three months it was tried out on runs from Detroit to Ann Arbor and other nearby cities, and was driven around Grosse Ile over rural roads, and given other endurance tests. To the surprise of the officials, it came through these better than they had expected. Then, without any announcement whatever, it was put into service on June 25 last at



Electric Truck for Animal Rescue, Operated by the Massachusetts Society for the Prevention of Cruelty to Animals. The Tailboard is Lowered to Form an Incline for the Ingress of Sick Animals.



Put Cutler-Hammer Charging Equipment Back of Your Electrics

Whether you have one vehicle or a hundred to keep in efficient (full mileage) running condition, the charging can be conveniently and economically done by Cutler-Hammer Unit Sectional Type Charging Equipment and the best interests of the user, central station and vehicle manufacturer served.

Cutler-Hammer Equipment Built on the Unit Plan—Extensions Easily Made

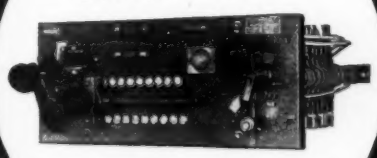
The Cutler-Hammer Unit rheostats can be supplied as desired and additions made when needed at small cost and without completely rearranging or scrapping the original equipment.

The principal advantages are:

Ease of making additions
Ease of operation
Low operating cost
Low installation cost
Automatic protection
One meter serves many charging outlets.

Electric vehicles to operate efficiently must be properly charged. Cutler-Hammer charging equipment insures you in this most vital particular. Let our nearest office know the number of vehicles you wish to charge.

One of the Cutler-Hammer Unit Type Rheostats



The basis of both small and large equipments.

The Cutler-Hammer Mfg. Co., Milwaukee, Wisconsin

We Have District Offices in

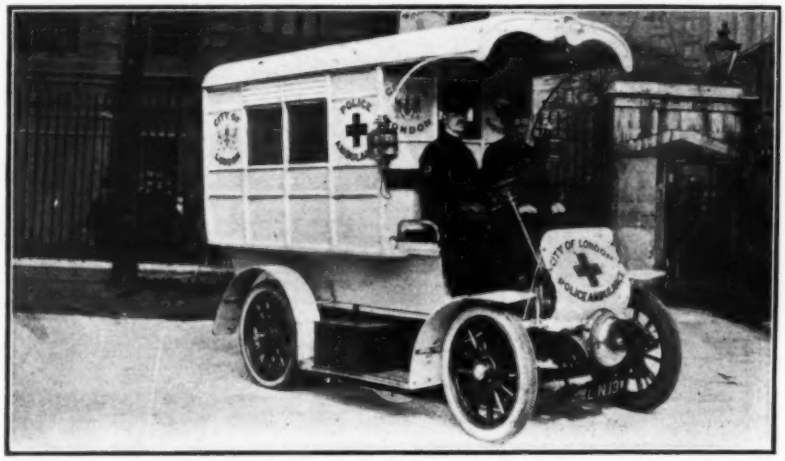
NEW YORK CHICAGO PITTSBURGH BOSTON PHILADELPHIA CLEVELAND CINCINNATI

On the Coast we are represented by H. B. SQUIRES CO., San Francisco, Portland and Los Angeles

Cutler-Hammer Charging Rheostats are Made for Charging all Types of Electric Vehicles

the Hotel Pontchartrain on a 12-hour-a day schedule, and left to work out its own salvation. It was not long before the public began to be heard from. More and more people who made their taxi engagements in advance, asked for the use of this particular cab. Old patrons of the company who had not shown any desire to be particular before, began to be annoyed if they could not get the electric when they wanted it. In one month, September, this car had a mileage of 1,375. In one day it made eight trips from the Indian Village to Grosse Pointe and came back smoothly under its own power. By the time the new electric had run 12,000 miles, including its road tests and actual service, it had proved itself without any doubt whatever. The public wanted it and it had the best record in every way of the seventy odd taxis operated by this company. In all this time this car had not had nor needed any repairs, and had never had any kind of an accident. It had gone through mud and high snow banks, and over the roughest kind of pavements and had never given the least trouble in any way. Ten more electric taxis, similar to the first in design but with some slight refinements in contour, are now being put into service, taking the place of 10 gasoline cars. As fast as they can be manufactured, other electric cars will be put on the runs, and by the end of this year it is reported that the Detroit Taxicab and Transfer Company will have practically all electric equipment, making a fleet of over 70 electric cabs.

Each of the cars used by the Detroit Transfer Company is said to have a capacity of 100 miles on a single charge, but to obviate difficulty a number of charging stations have been established, and at each cab-stand a charging apparatus is installed so that when a driver comes in from a run he puts his charging connection in and restores his batteries while waiting for another call. By this "boosting" system an unlimited mileage is assured.



The Well-Appointed Electric Police Ambulance Used by the London, England, Police Department.

Electric Police Ambulance in London.

The City of London police ambulances are operated by storage batteries. These vehicles are handsome models, painted with white enamel, with the insignia of the city conspicuously displayed, with the emblematic red cross on sides and dasher. The driver's seat is designed to accommodate an officer besides the chauffeur.

The battery, which is contained in a box slung from the chassis in such a manner as to be easily removed if required, consists of 45 special type Tudor cells, having a capacity of 135 ampere-hours. For the purpose of charging the battery a motor-generator by the British Thomson-Houston Company has been installed, consisting of a shunt-wound dynamo with an output of 35 amperes at 115 volts, direct coupled to a six-horsepower shunt-wound 400-volt motor running at 1,500 revolutions per minute. The machines are connected to a special Brook-Hirst switchboard consisting of a separate motor and generator panel, with all necessary instruments.

The Electric Police Patrol Wagon Installed by the Boston, Mass., Police Department.

New Electric Police Patrol Wagon for Boston.

A General Vehicle Company electric patrol wagon has been installed by the Police Department of Boston, Mass., at Station 4. The vehicle is of the worm-drive type, with Renault hood containing the battery. Motor, controller and other apparatus are under the driver's seat.

A feature of the brake gear is an arrangement by which, when the levers are applied, the controller goes to the neutral point and cannot be again put on until the brakes are released.

The body is eight by five feet, and six feet high, with swung-up side seats and electric lights.

Tests on Tremont Street showed a velocity of 23.5 miles an hour. An important feature of the new wagon is the quickness with which it leaves the station, only 20 seconds elapsing between the completed call and the time the vehicle is on the street—a marked advance over horse drawn wagons.

Seventy-five different industries in New York City use electric trucks. In hospital service the electric has long been a favorite in that city. Even where high-powered modern gas cars are used, the electric still retains its popularity.

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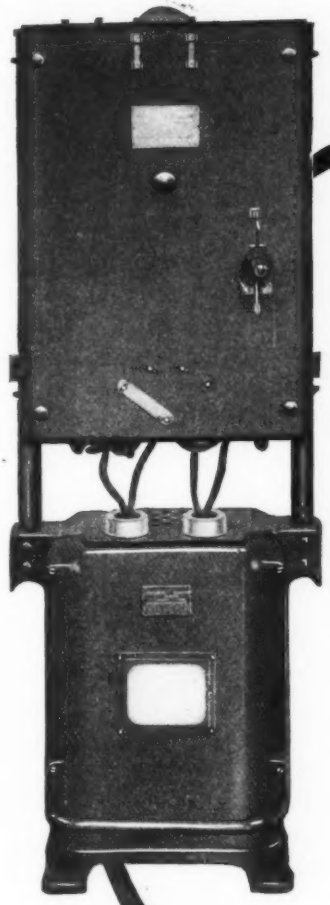

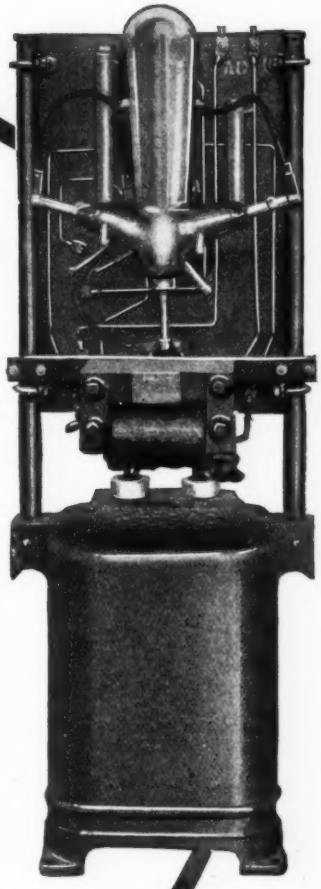

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for

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A simplified economical Mercury Arc Rectifier for charging batteries ranging from 38 to 46 cells of lead or the equivalent in Edison, from 220 volts, 60 cycles.

This New G-E Rectifier is adaptable to either rapid or slow charging.

It is the ideal outfit for the private garage—charging the electric at home.

It is easily operated by anyone who can run an electric car.

It occupies small floor space and requires no oil or grease.

It can be used with equal facility for charging batteries for light commercial cars.

The above points make a strong appeal to the owners of electric pleasure and about town business cars.

To the Central Station the G-E Mercury Arc Rectifier is always a good proposition for increasing the night load.

Send to our nearest office for further particulars.

General Electric Company

List of Sales Offices on Second Page Before Editorial Section 5311

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Unit Type Battery Charging Equipment in Small Private Garage.

Because of trouble and expense of charging equipment originally installed in the garage of A. B. Hastings & Son, Campello, Mass., a change has recently been made which has effected very satisfactory results. The electric service furnished this concern is single-phase, alternating current so that the charging equipment is now made up of two Wagner rotary converters used in combination with section or unit type of charging rheostats which are made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Since the new equipment has been installed expense or repairs and renewal of parts has been eliminated and the mileage of the wagon, it is reported, has been increased 20 per cent to 30 per cent. The illustration, Fig. 1, shows the four sectional charging units mounted on the middle frame with a Wagner rotary penal on each side. The charging is easily cared for, no technical experience is necessary. The rheostat handles are within easy reach conveniently arranged for charging a number of electrics at the same time from the one location. Automatic protection against overcharge, against charging back into the line, etc., are easily obtained. The second illustration, Fig. 2, shows the rotaries as well as the neat back of the Cutler-Hammer charging panel. The rheostat units and panels are furnished completely wired, the service and battery leads only need be secured to accessibly located lugs.

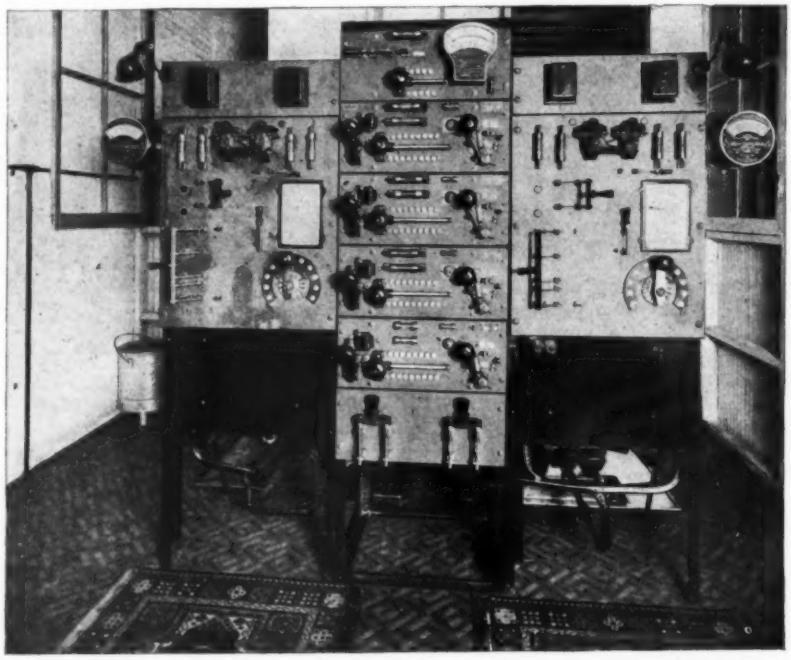


Fig. 1.—Battery-Charging Equipment in the Garage of A. B. Hastings & Son, Campello, Mass., Where Alternating-Current Service is Supplied by the Electric Company. Wagner Rotaries and Cutler-Hammer Unit-Type Charging Rheostats are Installed.

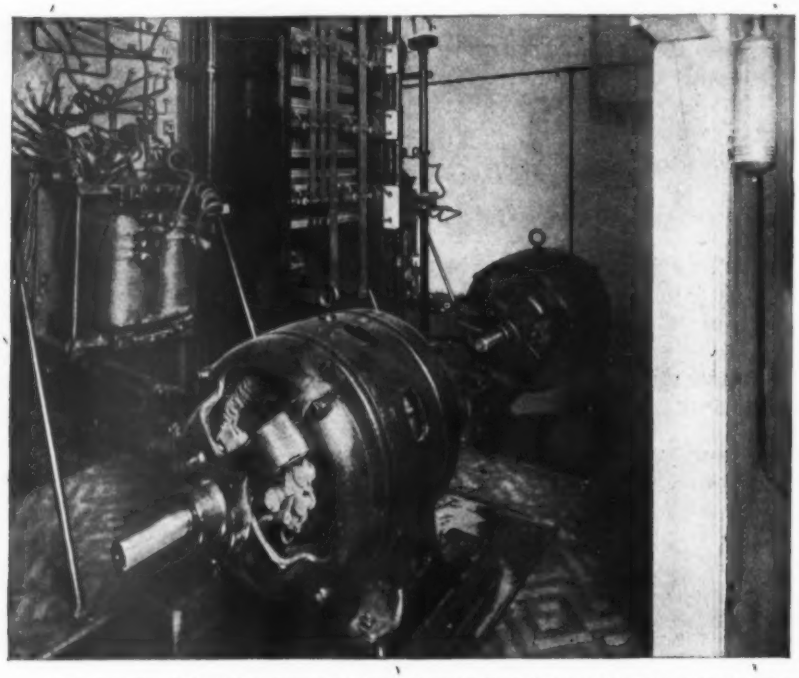


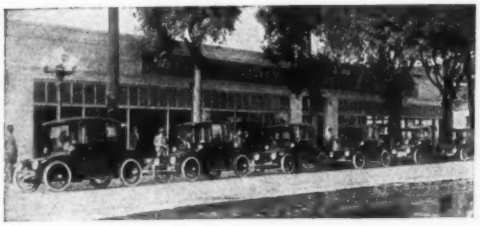
Fig. 2.—The Alternating-Current-Direct-Current Rotaries are Shown in the Foreground, and in the Rear is the Charging Panel in the Private Garage of A. B. Hastings & Son, Campello, Mass.

Electrics in England.

The English Commercial Motor Users' Association is holding examinations for drivers this year, and the Electric Vehicle Committee will offer prizes valued at $50 to drivers of electrics. Seventy-one electricity supply authorities are ordering the committee's official charging-station signs, 25 will use illuminated signs as already illustrated in our pages, and 46 will use enamel plate signs.

The surveyor to the Barnes local authority has prepared a detailed report on his experience with the working of two electrically propelled dust vans. One of these was an Edison van which cost $4,725 complete, the body of which was tipped by a small motor driven from the main battery, taking only 10 to 15 seconds to tip; speed about 10 miles per hour; radius 40 to 45 miles. The other was a Baker electric chassis (Wolsey) costing for chassis and battery, without body, $3,300. A temporary body was fitted by the surveyor, but adding $450 for end tipping gear, the cost was reckoned as $3,750. Speed and radius as in the case of the Edison cart. In both cases the running cost per day, including interest and repayment on the loan, wages, current, tires, maintenance of battery and chassis, insurance and all waste and sundries, worked out at $4.64. In both cases allowances were made for interest and repayment on $1,000 required for charging apparatus.

The surveyor says that one van will take the place of 16 horses per week, and as the number of horses and carts required for dust removal averages 62 per week, four vans will do the work with a small margin to spare. The saving for a year is calculated at $2,054, with a capital expenditure of $20,000, but there would be a material saving of time in collecting and travelling, a point of importance in regard to public health.



More Enviable Records

For Gould-Battery-Driven Electrics

How Many Electric Cars Do You Know of That Are Good For 100 Miles Per Charge?

Fourteen Beardsley Electric Cars started out from Los Angeles, Cal., on the morning of December 12, 1914, traveled over difficult hilly roads to Santa Ana and Orange, returned in a pouring rain and were operated to the limit of battery power. All were stock models driven by their owners.

Thirteen of these cars, owned and driven by men who had seen the wisdom of equipping with Gould Batteries, averaged over 100 miles each, on the single charge. The best record, over 112 miles, was made by a Gould-Battery-driven car that had been in active service for a year!

The fourteenth car, which had batteries of another prominent make, failed at 90 miles, after having made the poorest showing of all.

Do you wonder then that Gould Battery owners invariably become Gould Battery enthusiasts?

If you have been unfortunate enough to have some made-to-sell-at-a-price battery foisted upon you, either for driving an electric car or for starting and lighting your gas car, you will be agreeably surprised with your first Gould Battery.

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Waverley Models for 1915.

While the Waverley Company of Indianapolis, Ind., builds a complete line of electric pleasure cars and trucks including eight different models of the former and six of the latter, its chief attention for 1915 will be concentrated on two cars particularly, viz., the newly designed Waverley four-chair brougham Model 109, and the completely redesigned and reconstructed Waverley 1,000-pound wagon.

In body construction, seating arrangement and design, Model 109 is most distinctive and original. The beauty of its lines and the convenience and luxury of its four-chair seating arrangement mark the car as altogether different from the usual type of electric brougham.

Aluminum is used very largely in the body construction, roof and panels being made entirely of this metal. The roof is made in a single piece, well padded with felt and canvas to eliminate noise. The rear corners of the body are rounded, the side panels of the car and battery boxes being of integral construction, adding to the strength and durability of the car. Oval windows in the rounded rear corners form an attractive feature of the design. Wadding is used under all strainers to eliminate rattle.

The battery is dropped low between the sills allowing of small well rounded battery decks. Frameless glass is used throughout. The window openings are of unusually large size. The seating arrangement which has been standardized by a year's use is a combination of the rear seat drive with full view ahead and an individual seat for the driver.

In this car each passenger occupies a separate chair, the rear group of three having the middle seat spaced slightly behind the other two, while the fourth passenger is accommodated on a folding cosy-corner seat in the right front corner.

A feature of the mechanism is the five-quarter spring suspension, full elliptic being used and attached to the body by a fifth quarter-spring designed to take care of the torsional movements of the car.

The Waverley motor is a special series wound motor of special design, having the desirable characteristics of a high-speed motor, 1,500 revolutions per minute, and possessing unusual over load capacity for climbing hills.

The Waverley transmission is a parallel shaft drive taking its power from the motor head through a flexible gear and transmitting it by double helical or herringbone gears to the full-floating rear axle.

Improvements in the Waverley 1,000-pound delivery wagon are chiefly in the direction of increased strength and efficiency.

Among the improvements is a full floating rear axel of 25 per cent greater strength. The brakes, both expanding on the rear wheel drums, are 16-inch diameter, give 200 square inches of braking surface and are controlled by separate pedals.

The battery compartment is boiler-plate steel with room for different size batteries to give various mileages, ample ventilation and hold-down features. It is supported by two U-channels, reinforced by truss rods passing under the battery compartment and attached fore and aft to the chassis frame. Turn buckles provide for correct tension. The regular battery is 42-cell, 11-plate lead.

Standard panel body is 43 inches wide at floor and 46 inches above swell, 73 inches long and 56 inches high. A speed of 14 miles per hour and a mileage of 55 is normal.

A Waverley electric 1,000-pound delivery wagon recently made a trip from Buffalo to Lockport and back bringing a 900-pound load on the return trip in a total running time of three hours and a half. The current used on the round trip was 105 ampere-hours, which, at regular rates in Buffalo, amounted to less than ten cents.

On another occasion the same car made the same round trip and about 18 miles of additional travel, or 70 miles in all, on 130 ampere-hours.

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